PB 187 302

COLLECTION AND DISPOSAL OF SOLID WASTE FOR THE DES MOINES METROPOLITAN AREA

City of Des Moines, Iowa

1968

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PB187302

COLLECTION AND DISPOSAL OF SOLID WASTE FOR THE DES MOINES METROPOLITAN AREA

An Interim Report

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service

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This report has been reproduced as received from the grantee. No editorial or other changes have been made, although a new title page, preface and abstract have been added.

Since this is an interim report of progress, the conclusions and recommendations presented should be considered as preliminary in nature, pending completion of the project and final evaluation of findings.

PB 187 302

COLLECTION AND DISPOSAL OF SOLID WASTE FOR THE DES MOINES METROPOLITAN AREA

A Systems Engineering Approach to the Overall Problem of Solid Waste Management

An Interim Report

By Henningson, Durham & Richardson, Inc., Omaha, Nebraska
Associated with Veenstra & Kimm, West Des Moines, Iowa
Under Grant No. DO1-UI-00060

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service
Environmental Control Administration
Solid Wastes Program
Cincinnati
1968

PREFACE

An estimated 800 million pounds of solid wastes of all types are produced in the United States every day. What to do with these solid wastes, how to dispose of them without needlessly endangering public health and welfare, and how to recover and reuse valuable materials now "thrown away" are among the most challenging and perplexing of current national problems. Because of lack of suitable planning, interest, and public understanding, these problems have reached such proportions that nationwide attention is demanded and action for the development of adequate solutions must be taken.

Intensified action concerning these problems was made possible by the Solid Waste Disposal Act, Title II of Public Law 89-272, which was signed by the President on October 20, 1965. This legislation directs the Secretary of the Department of Health, Education, and Welfare to initiate, encourage, and support a national program aimed at discovering and evaluating better methods of coping with the solid waste problem.

The Secretary is authorized (1) to conduct and support research on the nature and scope of the problem, on methods of more safely and efficiently collecting and disposing of solid wastes, and on techniques for recovering from solid wastes potentially valuable materials and energy; (2) to provide training and financial and technical assistance to local and State agencies so that they can survey their needs in the solid waste area and plan for the development and staffing of programs capable of meeting those needs now and in the years to come; and, (3) to encourage and support projects that may demonstrate new and improved methods of solid waste collection, handling, and disposal.

To carry out these responsibilities, the Solid Wastes Program was established. Among the responsibilities with which the Program is charged is that of providing grant support for demonstrations relating to the development and application of new and improved methods of solid waste collection, storage, processing and ultimate disposal; and also for studies and investigations that may lead to a demonstration of improved disposal practices, or may provide solutions for regional or national solid waste disposal problems. Associated with this is the responsibility of collecting and making available by appropriate means the results of, and other information pertaining to, such federally supported demonstrations, studies and investigations.

Accordingly this report has been reproduced to disseminate as widely as possible the latest available information and findings of a project that has received grant support from the Solid Wastes Program. It is hoped that it will provide those working in this field with useful information that will be of assistance in developing approaches to the solutions of their solid waste disposal problems.

This report provides information to persons interested in solid waste collection and disposal and is especially useful because of the data given on: (1) the detailed organization of an intergovernmental solid waste collection and disposal agency; (2) the detailed plan and analysis of the collection routes and system; (3) the excellent surveillance program of refuse disposal in landfills and resultant detailed computer data processing.

This publication is an interim report of project progress. Additional data is being developed related to increased amounts of domestic waste expected as a result of changed collection practices outlined herein. Following evaluation, this additional information will be consolidated with the present interim report into a final project report.

-- RICHARD D. VAUGHAN
Chief, Solid Wastes Program

ABSTRACT OF STUDY AND INVESTIGATION GRANT NO. D01-UI-00060

TITLE: Des Moines Metropolitan Area Solid Waste Study and Investigation

GRANTEE: City of Des Moines, Iowa

PROJECT DIRECTOR: Leo J. Johnson, P. E., Director of Public Service
City Hall
Des Moines, Iowa 50309

PROJECT STARTED: April 1, 1967 PROJECT ENDS: March 31, 1968

OBJECTIVES: To demonstrate how a regional solid waste management plan can be developed.

PROCEDURES: A comprehensive study and analysis will be made of present solid waste collection and disposal operations in the Des Moines metropolitan area. Recommendations will be developed for the most suitable regional system for the collection and disposal of solid wastes in the area.

The consulting engineering firms of Henningson, Durham and Richardson, Omaha, Nebraska, and Veenstra and Kimm, Des Moines, Iowa, are conducting the study, which includes the following elements: (1) an analysis of the quantities and nature of solid wastes generated in the study area; (2) determination of present solid waste collection and disposal practices and costs; (3) recommendations for regional solid waste collection practices and cost estimates; (4) investigation of possible disposal methods and recommendations of the preferable method or methods of disposal; (5) a thorough investigation of existing laws regulating solid waste collection and disposal in the study area, and a recommendation for and formulation of laws needed to implement recommended collection and disposal procedures; (6) an analysis of existing administrative procedures and recommendation of a system for administering the proposed solid waste program; and (7) recommendations for the best means of financing both the capital and operating costs of the proposed programs.

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May 16, 1968

Mr. Leo L. Johnson, P.E.
Project Manager
City Hall
Des Moines, Iowa 50309

Re: Report for the Des Moines
Metropolitan Area - Collection and Disposal
of Solid Waste

Dear Mr. Johnson:

In accordance with our Engineering Agreement dated November 28, 1966, we are submitting herewith our report, Des Moines Metropolitan Area-Collection and Disposal of Solid Waste 1968.

The conclusions and recommendations of our study are summarized in the Topical Summary which follows this letter.

The information included in the body of the report and in the Appendix is presented in detail.

We have enjoyed making this report for the communities and counties in the Metropolitan Area of Des Moines, and are available for any future services you may desire.

Respectfully submitted,

HENNINGSON, DURHAM & RICHARDSON, INC.

Russell J. Peterson
Russell J. Peterson, P.E.
Project Engineer

VEENSTRA & KIMM

Richard G. Glenn, Assoc. AIP
Associate Project Engineer

REPORT
FOR THE
DES MOINES METROPOLITAN AREA
COLLECTION AND DISPOSAL
OF
SOLID WASTE

1968

HENNINGSON, DURHAM & RICHARDSON, INC.
ENGINEERING · ARCHITECTURE · PLANNING
OMAHA, NEBRASKA

ASSOCIATED WITH

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CONSULTING ENGINEERS
WEST DES MOINES, IOWA

ACKNOWLEDGMENT

The development of this report has been made pleasurable by the cooperation of the many persons and organizations that were contacted during the study period.

Especially grateful acknowledgment is rendered to the Project Manager, Mr. Leo L. Johnson, P.E., who is the Director of Public Works of the City of Des Moines; and to his assistant, Mr. Harold E. Smith, P.E., for their enthusiastic cooperation and assistance during this study.

The preparation of this study and report was financially aided in part by a grant from the U. S. Public Health Service, Department of Health, Education and Welfare.

HEW Grant No. 1-D01-UI-00060-01

TOPICAL SUMMARY

A. INTRODUCTION

This summary presents briefly the major conclusions and recommendations which were developed during the course of the study and preparation of this report. Analyses of the recommendations and conclusions and the alternatives are discussed in detail in the body of the report.

B. POPULATION

The existing population of the Study Area is estimated at 288,000. It is expected to reach 361,000 by 1980 and 418,000 by 1990.

C. SOLID WASTE SURVEY

The total amount of all solid waste presently being disposed of in the Study Area is approximately 1,016,000 cubic yards per year (after compacting) or 562,000 tons per year. This includes waste disposed of at the ten dump and landfill sites in the Study Area and that disposed of on site by private individuals, business and industry. It is estimated that these annual waste quantities, for which proper disposal facilities must be provided, will reach 1,500,000 cubic yards or 783,000 tons by 1990.

During the years from 1967 through 1990, the accumulation is estimated to be 29,500,000 cubic yards or 15,870,000 tons. As an illustration of the magnitude of this accumulated volume; if piled on a football field within the playing area, the pile would be more than sixteen thousand feet high.

D. SOLID WASTE COLLECTION

1. An area wide public collection system is recommended to replace the various municipal, contract and private systems now being operated. This system would provide weekly collection of all domestic waste from the dwelling units within the Study Area, which is a change from the present practice of collecting only garbage or kitchen waste. No public collection service would be offered to large multiple family dwellings, commercial or industrial waste producers.

2. Private refuse haulers should be licensed and regulated. They would continue to serve that part of the community not receiving public collection service.

3. The new collection system includes combining the existing manpower and equipment of the Des Moines, West Des Moines and Urbandale collection systems into a single, efficient area-wide collection system. New routes, standards, work rules and administrative and technical procedures have been developed to implement the program.

4. The cost to provide total collection service to each dwelling unit in the Study Area is estimated to be $0.90 per month or $10.80 per year. This cost, which is less than the present costs for collecting kitchen waste only, also includes disposal costs of the collected refuse.

E. SOLID WASTE DISPOSAL

1. The sanitary landfill method of waste disposal is recommended as being the most economical, practical and efficient method for the Study Area. Two sanitary landfill site locations are proposed, of sufficient size, to dispose of the estimated Study Area waste for the 20 years from 1968 through 1987.

2. A fee system is proposed for the use of the sanitary landfill sites which will produce sufficient revenue to make the disposal operations entirely self-supporting, and to amortize the initial cost of equipment, land and improvements.

3. Interim improvements and a temporary fee system are proposed for the existing Des Moines landfill sites. These improvements contemplate converting these sites to model sanitary landfills as a public relations aid to the establishment of the permanent new sites.

4. An area-wide disposal agency is proposed to manage, own and operate the new sanitary landfill sites.

F. SOLID WASTE AGENCY

1. A Metropolitan Solid Waste Agency is recommended which will be responsible for the collection and disposal of all solid waste produced within the Study Area. This Agency would be governed by a Board composed of certain elected representatives of the 14 cities, towns and counties in the Study Area.

2. The Agency will provide collection services to all member municipalities on a contract basis of approximately $10.80 per year per dwelling unit. The Agency will also operate the two sanitary landfill sites, open to anyone wishing to dispose of solid waste, for a fee of approximately $1.10 per ton.

3. The initial capital expenditures of the Agency will be financed by a revenue bond issue. Sufficient revenues are anticipated from the fees proposed for the collection and disposal operations to retire the bonds as well as provide the necessary maintenance, operating and administrative costs of the Agency.

4. Uniform waste collection and disposal ordinances to be adopted by all Agency member communities are recommended. Model ordinances have been prepared and included in the report.

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PART ONE - GENERAL

A. Scope. The objective of this study is to analyze the present collection and disposal practice and long range area wide problems in the metropolitan area, and to recommend and develop procedure to implement solutions. The study has been divided into five major parts:

1. Characteristics of the Study Area.
2. The solid waste generated within the Study Area.
3. Solid waste collection.
4. Solid waste disposal.
5. Formation of a Metropolitan Solid Waste Agency.

The report examines and discusses the following items:

1. Potential growth of the Study Area including population and growth patterns.

2. Analysis of on-site accumulations and disposal of solid waste in the metropolitan area.

3. Special problem waste including junked automobiles, diseased trees, packing house waste, sewage sludge and other wastes.

4. Study and survey of all disposal sites in the metropolitan area to determine the quantity and nature of existing solid waste.

5. Future quantities of solid waste based on present quantities and economic, land use and population projections to 1990.

6. Basic collection systems and scope of service.

7. Existing collection policies.

8. Types of collection systems in use in the Study Area.

9. Evaluation of the organization, operation and financing of existing municipal collection agencies.

10. Recommended interim improvements for existing system.

11. Recommended future collection system for the entire Study Area.

12. Recommended agency to operate future collection system.

13. Methods available for solid waste disposal.

14. Recommended future disposal methods.

15. Analysis of existing disposal operations.

16. Selection of future disposal sites.

17. Cost of future collection and disposal systems.

18. Establishment of an area wide solid waste agency, including organization, operation and financing.

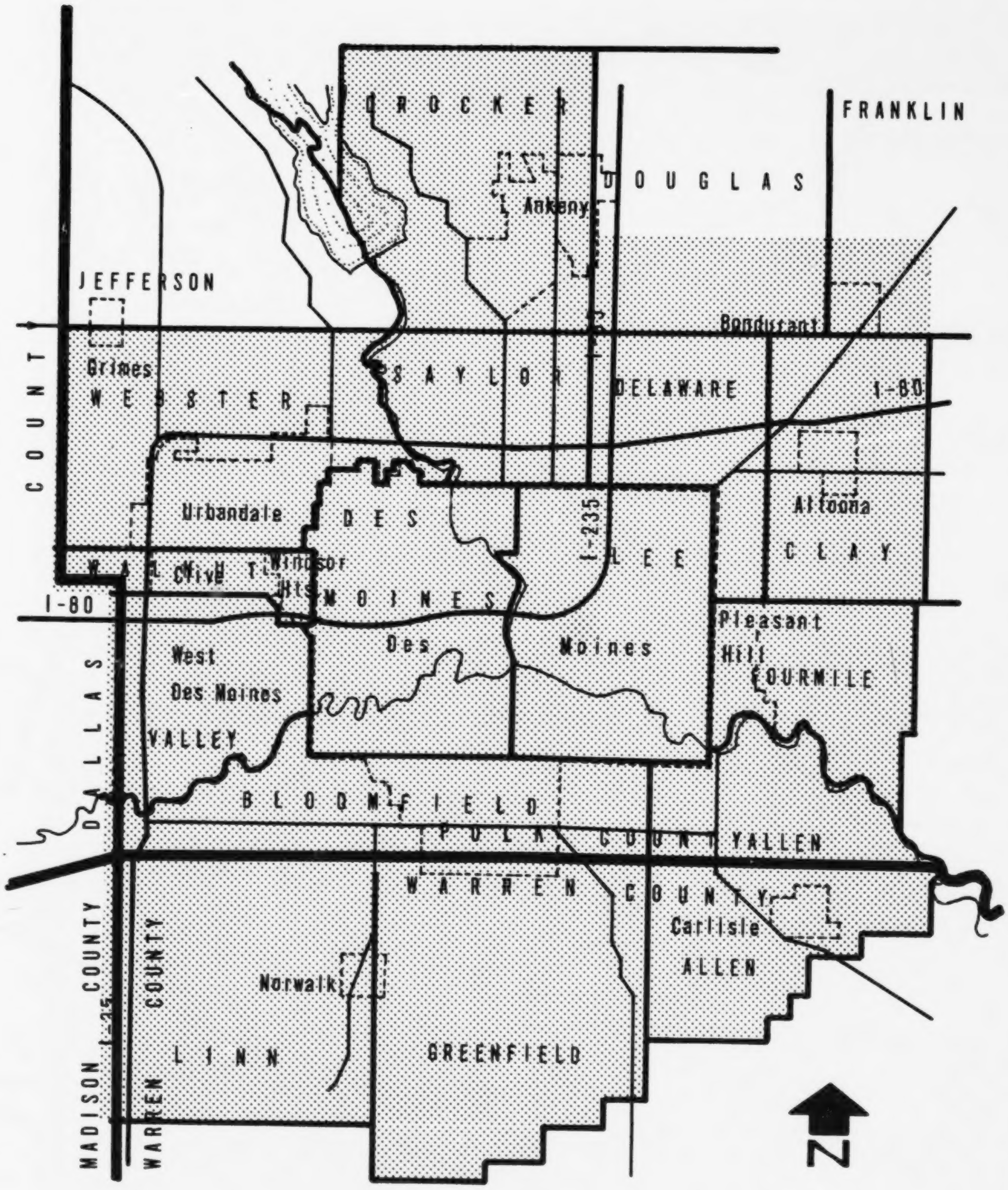
19. Suggested state and municipal legislation.

B. Description of Study Area. The Study Area as established for purposes of this report comprises approximately 430 square miles, includes 12 cities and towns and parts of two counties, as shown on Figure 1-1. Specifically it includes the following governmental jurisdictions or political units:

1. Town of Altoona.
2. City of Ankeny.
3. Town of Bondurant.
4. Town of Carlisle.
5. Town of Clive.
6. City of Des Moines.
7. Town of Grimes.
8. Town or Norwalk.
9. Town of Pleasant Hill.
10. City of Urbandale.
11. City of West Des Moines.
12. City of Windsor Heights.
13. Unincorporated townships in Polk County, including Crocker, Webster, Saylor, Delaware, Clay, Four Mile, Allen, Bloomfield, Walnut, part of Douglas, and part of Franklin.
14. Unincorporated townships in Warren County, including Linn, Greenfield and Allen.

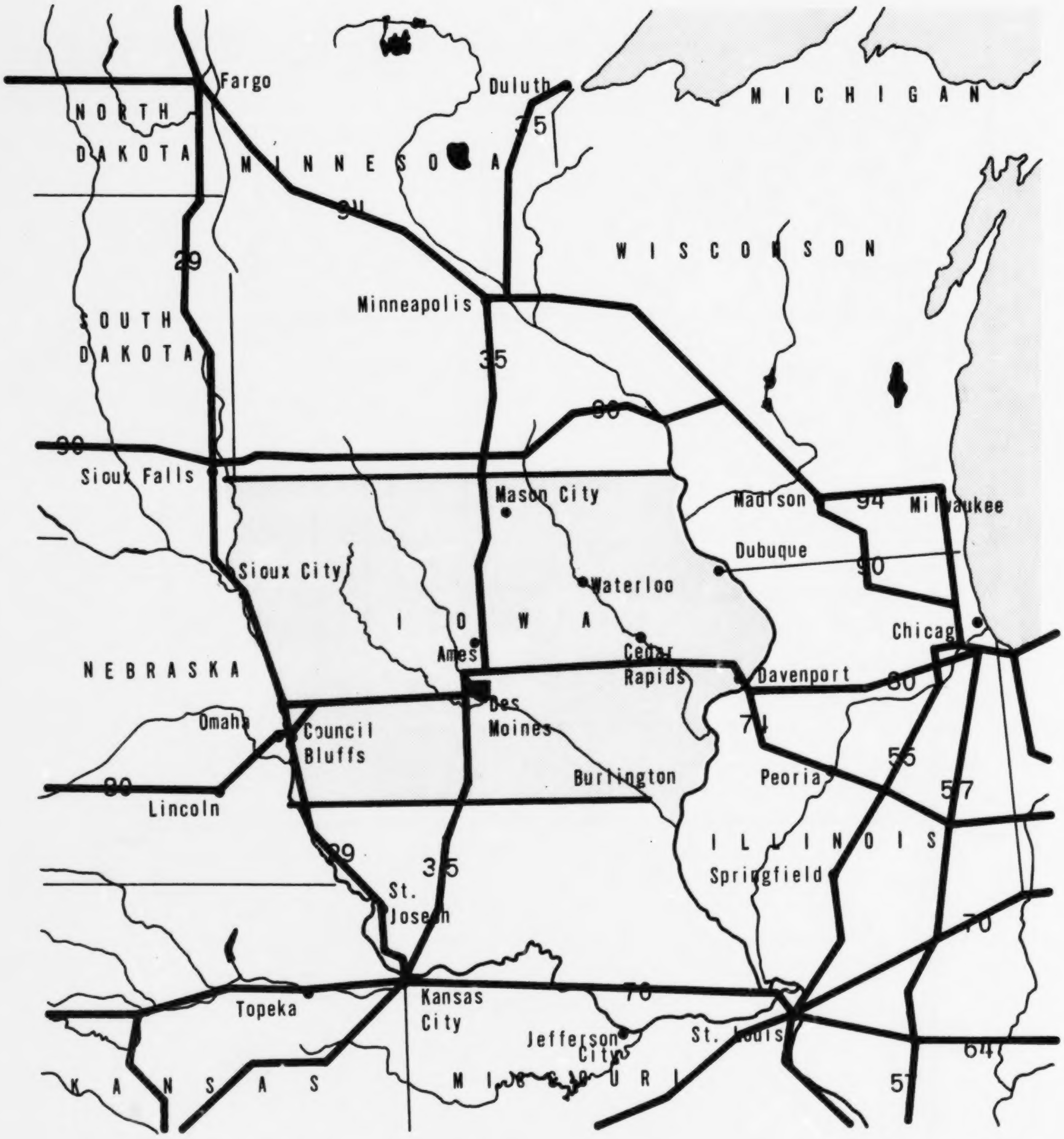
Des Moines, the principal city in the area, is the county seat of Polk County and the capital and largest city in the State of Iowa. It is located slightly southwest of the geographical center of the State at Longitude 93° 37' W, Latitude 41° 35' N. The City and surrounding area is served by Interstate Highways 80, 35 and 235, numerous other State and Federal Highways, three major air lines and nine rail routes.

Des Moines is well known as an insurance, printing and governmental center. Due to the excellent location and access to major transportation facilities, the area has become a principal mid-west distribution and shipping center for agricultural products, farm equipment, tires, concrete products and food products, all of which are processed or manufactured in the Des Moines area. Figure 1-2 indicates Des Moines' location with respect to other major cities in the State and the region.


CROCKER
FRANKLIN
DOUGLAS
Ankeny
JEFFERSON
Bondurant
Grimes
SAYLOR
DELAWARE
I-80
WEBSTER
COUNTY
Urbandale
DES
I-235
LEE
Altoona
CLAY
WALNUT
Clive
Windsor Hts
MOINES
I-80
Pleasant Hill
FOURMILE
West Des Moines
Des Moines
VALLEY
DALLAS
BLOOMFIELD
POLK COUNTY
ALLEN
WARREN COUNTY
Carlisle
ALLEN
Norwalk
MADISON COUNTY
WARREN COUNTY
LINN
GREENFIELD
N

METROPOLITAN
SOLID WASTE STUDY AREA

FIGURE 1-1


Fargo
Duluth
35
MICHIGAN
NORTH DAKOTA
MINNESOTA
94
29
WISCONSIN
Minneapolis
SOUTH DAKOTA
35
90
90
Sioux Falls
Mason City
Madison
94
Milwaukee
Dubuque
90
Sioux City
Waterloo
IOWA
Chicago
Ames
Cedar Rapids
NEBRASKA
Davenport
80
Des Moines
Omaha
Council Bluffs
74
55
80
Lincoln
Burlington
Peoria
57
ILLINOIS
29
35
Springfield
St. Joseph
70
Topeka
Kansas City
70
Jefferson City
St. Louis
64
KANSAS
MISSOURI
57

LOCATION IN THE REGION

FIGURE 1-2

The topography of the Study Area is dominated by the Des Moines and Raccoon Rivers, which divide the area into three sectors, the northwest, northeast and south. Most of the development within Des Moines and the surrounding cities and towns has been on the flat and gently sloping land rising from the broad flood plains of these rivers, and the major streams tributary to them. Among the latter are Walnut and Beaver Creeks in the northwest area, Four Mile Creek in the northeast and Middle Creek and the North River in the south area. The uplands generally lie above 900 feet elevation, with the flood plain elevations in the range of 800 to 850 feet above sea level. The transitional areas between the flood plains and the uplands are characterized by steep ravines and bluffs.

Geologically the entire area is underlain by the Pennsylvania System which forms the uppermost strata of solid or bed rock. This system, primarily shales, also includes sandstones, coals and limestones. The coal mined from this system played an important part in the early economic development of the area. Overlying the bedrock are deposits of various clays, sands and gravels, results of the last glacial drifts 50,000 to 1,000,000 years ago.

Wind blown loess, a uniformly fine grained soil, covers the glacial deposits. It ranges in depths of 5 to 30 feet and is generally visible wherever the topsoil has been removed throughout the area. Large amounts of silt, sand and gravel, deposited by the melting ice of the glacial ages are to be found as alluvial soils along the bottom lands of the river valleys.

The climate of the Study Area is marked by seasonal variations in temperature and precipitation. Average yearly temperatures approximate 50°, with monthly averages varying from the low 20's in January to the middle 70's in July. Extremes may vary from -30° in January to 110° in July and August. Mean annual precipitation is between 31 and 32 inches throughout the area, with much seasonal variation. About 22 inches or 70% of the total annual precipitation falls between April and September. 10 percent of the precipitation falls during the winter months with an average of 32 inches of snow. Northwest winds are predominate during the months from October through March at an intensity of three to four miles per hour greater than the summer winds, which prevail from the south and southeast.

The principal source of water for the area is the Raccoon River. The Des Moines Water Works besides supplying water to all developed parts of the City of Des Moines also wholesales water to the communities of Windsor Heights, Clive, Urbandale, Pleasant Hill and a number of private residential and industrial users in the adjoining areas of Polk County. The remaining cities and towns in the Study Area operate their own water supply systems, drawing principally from the Jordan Formation at depths of 2,500 feet and greater. The Towns of Norwalk and Carlisle utilize shallow wells in the sands and gravels of the North River.

Des Moines also supplies sewage treatment facilities for the major portion of the area population, through its main treatment plant located on the Des Moines River in the southeast part of the City. West Des Moines, Clive, the Urbandale - Windsor Heights Sanitary District and the Urbandale Sanitary District all have sewer service contracts with Des Moines. The remaining communities in the area operate their own sewage treatment facilities.

Natural gas, electric power and telephone service are provided throughout the area to all cities and towns by private utilities.

C. Existing Solid Waste Facilities

1. Collection. Three cities provide municipal solid waste collection: Des Moines, West Des Moines and Urbandale.

The Town of Pleasant Hill provides municipal-like service through a public contract with a private contractor.

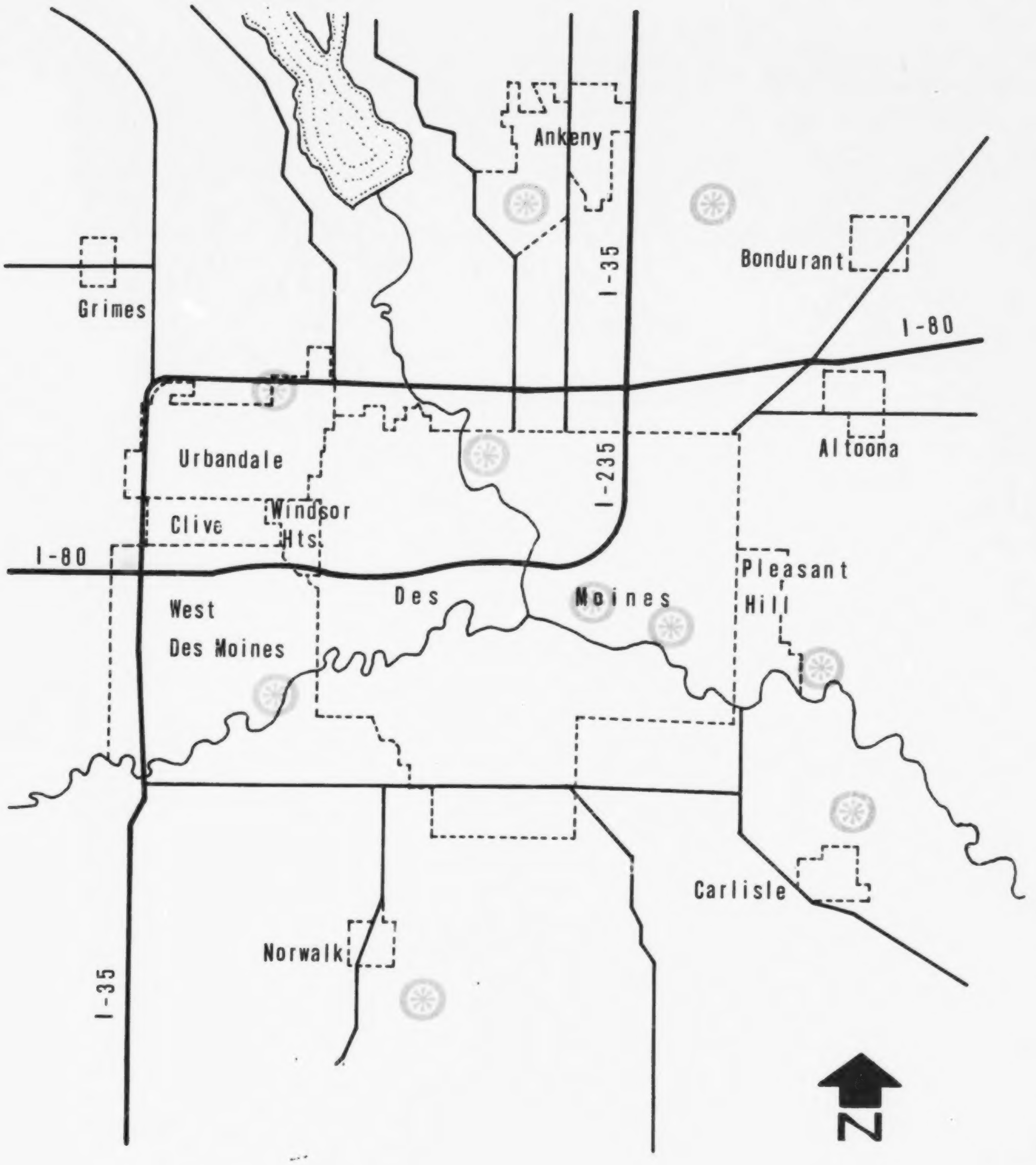
There is no other public collection service offered. In other parts of the Study Area, the individual is usually served by a private hauler.

2. Disposal. The location of major sites being used at the present time for the disposal of solid waste throughout the Study Area are shown on Figure 1-3. All of the sites are publicly owned with the exception of the open dump at 18th and Euclid, which is privately owned and operated, but open to the public on a fee basis.

A general description of the existing solid waste facilities is included in the following paragraphs. Additional discussion concerning each site will be found in other sections of the report.

a. Ankeny Landfill

Owner and Operator:	City of Ankeny; Dept. of Public Services.
Location:	Approximately 1/2 mile southeast of the John Deere Plant, adjacent to the John Deere Sewage Treatment Works.
Size:	Approximately 20 acres.
Hours:	9:00 A. M. to 5:00 P. M., Monday through Saturday.
Restrictions:	Use limited to residents of Ankeny, private haulers authorized to collect in Ankeny and maintenance personnel from the John Deere Plant and the Iowa State University Experimental Farm.
Comments:	City personnel on duty during dumping hours; garbage and food wastes covered daily; open burning of combustible refuse.


Ankeny
Bondurant
Grimes
I-35
I-80
Altoona
Urbandale
I-235
Clive
Windsor Hts
I-80
Pleasant Hill
West Des Moines
Des Moines
Carlisle
Norwalk
I-35
N

EXISTING DISPOSAL SITES

FIGURE 1-3

b. Carlisle Dump

Owner and Operator:	Town of Carlisle; Town Council.
Location:	East of C. R. I. & P. R. R. and south of North River.
Size:	Approximately 2 acres used for dumping out of 28 acre site owned by the Town.
Hours:	Open 24 hours per day, seven days a week.
Restrictions:	Use limited to residents and private haulers from Carlisle. Private hauler from Hartford allowed to dump for a fee.
Comments:	Employee on duty, part time; open burning of combustible refuse; refuse covered approximately once a week.

c. Des Moines No. 1 Landfill

Owner and Operator:	City of Des Moines; Department of Public Works.
Location:	E. 15th and Harriett Streets.
Size:	Approximately 70 acres.
Hours:	Gate open 7:00 A. M. to 7:00 P. M., seven days a week; open to private haulers with advance permission 7:00 P. M. to 7:00 A. M.
Restrictions:	No residence requirements; trees and brush, large bulk items and construction and demolition wastes diverted to No. 2 site.
Comments:	Burning prohibited, although accidental fires continually plague operation, attempts to cover daily have largely been unsuccessful due to lack of adequate cover material and equipment. City personnel on duty 24 hours a day. A number of improvements have been made recently regarding fencing, cover and road surfacing.

d. Des Moines No. 2 Landfill

Owner:	Private.
Operator:	City of Des Moines; Department of Public Works as lessee.
Location:	S. E. 30th and C. B. & Q Streets, formerly site of a sand and gravel pit.
Size:	Approximately 16 acres.
Hours:	8:00 A. M. to 10:00 P. M., Monday through Saturday.
Restrictions:	No residence requirements; waste restricted to inert materials and trees. No garbage or foodstuffs.

Comments: Burning prohibited; cover operations are generally behind due to lack of cover material and adequate equipment. City personnel on duty during dumping hours.

e. Euclid Dump

Owner: Private; operated by lessee.
Location: South of Euclid Avenue on the east side of the Des Moines River.
Size: Approximately 4 acres.
Hours: 8:00 A. M. to 5:30 P. M., seven days a week.
Fees: Automobiles - 25 cents; trucks 40 cents and up depending upon size.
Restrictions: Any material allowed except garbage and food waste.
Comments: Dump burns continuously, no attempt made to cover or compact material.

f. Norwalk Landfill

Owner and Operator: Town of Norwalk; Town Council.
Location: Approximately one mile south of Norwalk on public owned land, adjoining sewage treatment plant site.
Site: Site utilized is part of 148 acre tract owned by the Town, including sewage lagoon, leased land for farming and small area for landfill site.
Hours: 3:00 P. M. to 8:00 P. M., Monday, Wednesday and Friday, Noon to 8:00 P. M. on Saturday.
Restrictions: Open to residents of Norwalk only and to private haulers carrying from Norwalk.
Comments: All waste is dumped in open trench which is covered approximately once a month using trench excavation material. Trees and brush are burned separately on an irregular basis.

g. Pleasant Hill Town Dump

Owner and Operator: Town of Pleasant Hill; Public Works Department.
Location: Extreme southeast part of the Town on the south side of Vandalia Road.
Size: Approximately 9 acres.
Hours: 8:00 A. M. to sunset, seven days a week.
Restrictions: No garbage or foodstuff allowed; only residents of Pleasant Hill permitted to dump. Private haulers not permitted to use dump.

Comments: Town employee on duty during dumping hours: papers and combustibles burned at the discretion of attendant; waste covered and compacted on an approximate monthly basis; site was formerly sand and gravel pit; site protected from Des Moines River by levee.

h. Polk County Landfill

Owner and Operator: Polk County; Board of Supervisors.

Location: N. E. 78th Ave. and Berwick Drive.

Size: Approximately 25 acres in two sites; one site 5 acres and second about 20 acres.

Hours: 9:00 A. M. to 5:30 P. M., Tuesday through Saturday.

Restrictions: Open to residents and private haulers of unincorporated areas of Polk County only.

Fees: No charge for private individuals; commercial haulers pay a fee ranging from $1.50 to $6.00 depending upon type of vehicle. Several large industrial concerns pay a monthly fee for disposal of flammable solvents.

Comments: Employee on duty during dumping hours; domestic refuse including garbage covered daily in trench; some burning of paper and brush; large bulky items and demolition material, dumped on steep slope which is uncovered; general maintenance and site supervision is good except for exposed slope.

i. Urbandale Sanitary Landfill

Owner and Operator: City of Urbandale; Department of Public Works.

Location: In future park site, south of Interstate 35-80 and west of 72nd Street.

Size: Area being filled is small gully approximately 1 acre in size.

Restrictions: Not open to the public, used only by City refuse truck.

Comments: Waste is covered daily with large amount of fill; very clean and well managed but extremely small operation. No burning.

j. West Des Moines Dump and Landfill

Owner and Operator: City of West Des Moines; Department of Public Works.

Location: South end of 11th Street, south of the railroad tracks.

Size:	Approximately 15 acres split into three separate areas for garbage, general trash and refuse, and trees and brush.
Hours:	9:00 A. M. to 8:00 P. M., seven days a week.
Restrictions:	Open to residents of West Des Moines only.
Comments:	Garbage covered daily in separate area; trash and general refuse covered when cover material is available; trees and brush burned in separate area. City employee on duty during dumping hours.

D. Population. An analysis of the past, present and future population trends of a community are a necessary prerequisite to planning future solid waste facilities. The quantity, type and volume of solid waste that is generated, and for which provisions for disposal must be made, are related to the population and the associated commerce and industry, which support the population.

It should be noted that the population figures included in this report have been tabulated for the areas included in this study, which have previously been discussed, and are shown on Figure 1-1. The Study Area population figures should not be confused with the Bureau of the Census designation of the Des Moines Standard Metropolitan Statistical Area (SMSA), which includes all of Polk County; or the Des Moines Urbanized Area, which includes only Des Moines and those existing builtup areas immediately adjoining Des Moines.

Population trends in the Study Area since 1940 have been as follows:

Year	Population
1940	190,935
1950	221,812
1960	262,781
1966	282,263
1967 (Estimate)	287,900

Population figures for the years 1940 through 1960 are based on U.S. Bureau of the Census statistics. 1966 figures represent the results of Special Censuses taken in the majority of the cities and towns in the Study Area during 1965 and 1966, plus estimated increases in those areas where no Special Census was conducted.

Although population for the area as a whole has been increasing at a fairly uniform rate since 1940, increases within individual communities have varied considerably. Table 1-1 indicates the population changes and shifts that have occurred since 1940 in each of the 12 cities and towns and parts of the 2 counties. The table points out the significant increases in the population of the cities and towns outside of Des Moines, typical of suburban growth in metropolitan areas throughout the country.

Table 1-1

Population Changes Within the Solid Waste Study Area

	1940	1950	Percent Increase	1960	Percent Increase	1965 or 1966 Special Census	Percent Increase
Altoona	640	763	19.2	1,458	91.1	2,424	66.3
Ankeny	779	1,229	57.8	2,964	141.2	5,910	99.4
Bondurant	320	328	2.5	389	18.6	-----	----
Carlisle	690	903	30.9	1,317	45.8	1,930	46.5
Clive	---	---	--	752	---	1,735	130.7
Des Moines	159,819	177,965	11.4	208,982	17.4	206,739	-1.1
Grimes	489	582	19.0	697	19.8	---	--
Norwalk	377	435	15.4	1,328	205.3	1,630	22.7
Pleasant Hill	---	---	--	397	--	1,006	153.4
Urbandale	1,083	1,777	64.1	5,821	227.6	10,310	77.1
West Des Moines	4,252	5,615	32.1	11,949	112.8	13,720	14.8
Windsor Heights	---	1,414	--	4,715	233.5	6,409	35.9
Parts of Polk & Warren Counties	22,486	30,801	36.9	22,012	- 28.5	29,150*	32.4

Source: U. S. Census of Population

*Estimated Population

Another indication of the increased growth of suburban areas in comparison to the central city (Des Moines), is shown in Table 1-2. Of particular significance is the fact that Des Moines in 1940 accounted for almost 84 percent of the Study Area population, while in 1966 this has been reduced to slightly over 73 percent.

Due to new incorporations and annexations the increased growth in Polk and Warren Counties is not truly reflected in Tables 1-1 and 1-2. This growth has been significant particularly in the unincorporated areas adjoining Des Moines on the north and south.

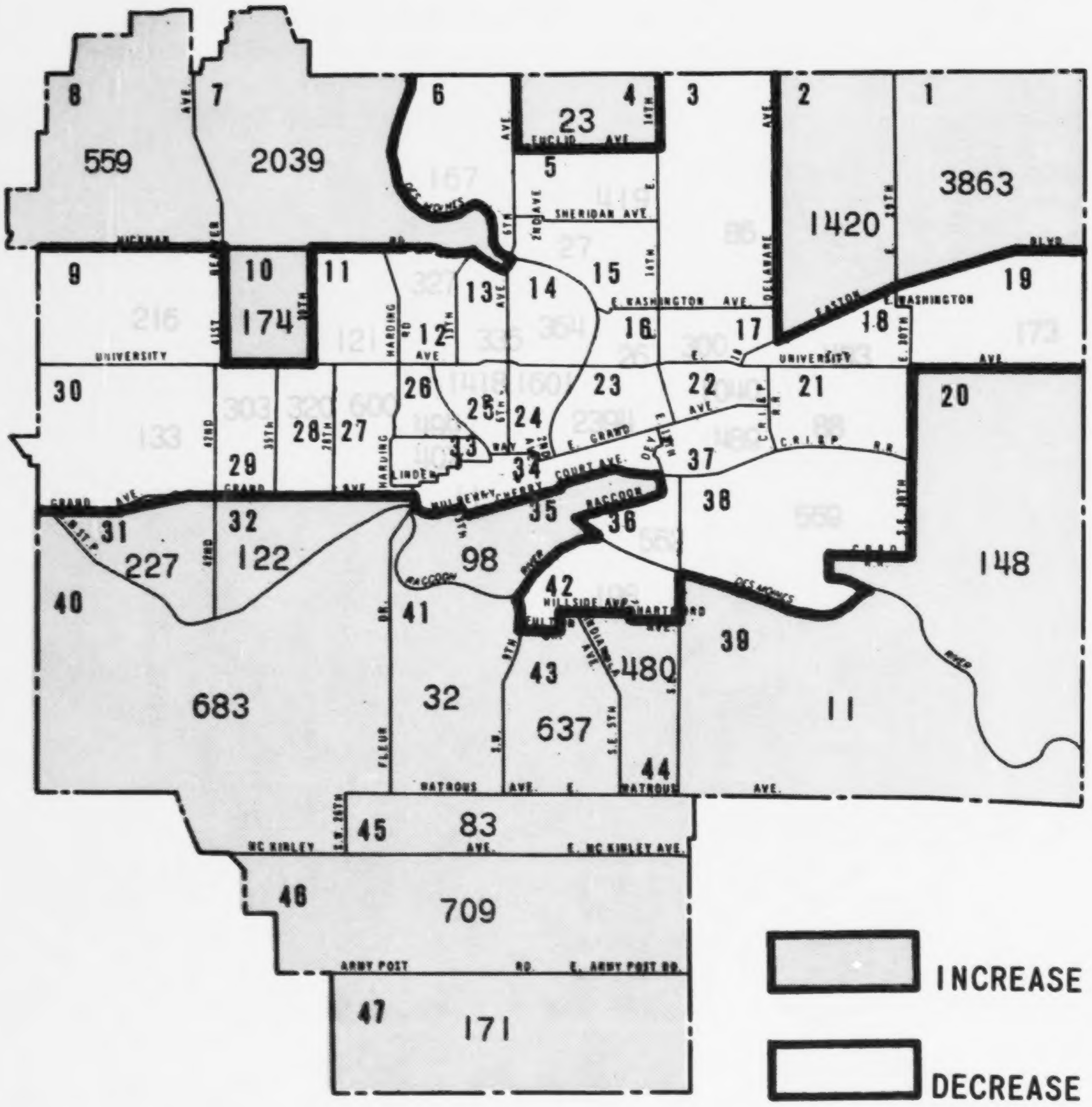
In addition to the population shifts in the suburban parts of the Study Area, significant changes have also been occurring within the City of Des Moines. Figure 1-4 indicates the population increases or decreases within individual census tracts in Des Moines between the 1960 Regular Census and the 1966 Special Census. Although the City had a net loss of 2, 243 persons during this period the changes within individual tracts varied considerably. All of the tracts in the central and older parts of the city had population losses, while the outlying areas in the northwest, northeast and south had population increases. Much of the loss in the central sections is attributable to the freeway construction and urban renewal, particularly in tracts 22 through 30.

Table 1-2

Population as a Percent of Total Study Area Population

	% of Total Pop. - 1940	% of Total Pop. - 1950	% of Total Pop. - 1960	% of Total Pop. - 1966
Altoona	0. 33	0. 34	0. 55	0. 86
Ankeny	0. 41	0. 55	1. 13	2. 09
Bondurant	0. 17	0. 15	0. 15	0. 18*
Carlisle	0. 36	0. 41	0. 50	0. 68
Clive	---	---	0. 29	0. 62
Des Moines	83. 70	80. 23	79. 53	73. 24
Grimes	0. 25	0. 26	0. 26	0. 28*
Norwalk	0. 20	0. 20	0. 50	0. 58
Pleasant Hill	---	---	0. 15	0. 36
Urbandale	0. 57	0. 80	2. 22	3. 65
West Des Moines	2. 23	2. 53	4. 55	4. 86
Windsor Heights	---	0. 64	1. 79	2. 27
Parts of Polk and Warren Counties	11. 78	13. 89	8. 38	10. 33

*Estimated


8
559
7
2039
6
23
4
3
2
1420
1
3863
5
EUCLID AVE.
SHERIDAN AVE.
DES MOINES
HICKMAN
BEAVER
9
10
174
11
12
13
14
15
16
17
18
19
E. WASHINGTON AVE.
EASTON
BLVD
UNIVERSITY
HARDING RD
DELAWARE
30
29
28
27
26
25
24
23
22
21
20
33
34
35
36
37
38
GRAND AVE.
E. GRAND AVE.
COURT AVE.
C.R.I.&P. R.R.
LINDEN
31
227
32
122
40
98
RACCOON
41
42
HILLSIDE AVE.
HARTFORD AVE.
DES MOINES RIVER
148
39
683
32
FLEUR DR.
43
637
480
11
44
WATROUS AVE.
45
83
MC KINLEY AVE.
E. MC KINLEY AVE.
46
709
ARMY POST RD.
E. ARMY POST RD.
47
171
INCREASE
DECREASE

POPULATION CHANGES
WITHIN
CENSUS TRACTS
1960 - 1966

FIGURE 1-4

Census statistics indicate that most of the population decrease was in the age groups under 5 years and between 25 to 64 years. This is indicative of the general trend of younger families in the child bearing age groups moving to newer housing in the outlying areas of the City and into the surrounding suburban communities.

Future population estimates have been prepared, based upon an analysis of past trends in each community, including family size, rate of dwelling unit construction and economic activity. Table 1-3 indicates the number of households and the average population per household, for communities in the Study Area, based upon 1960 Census information.

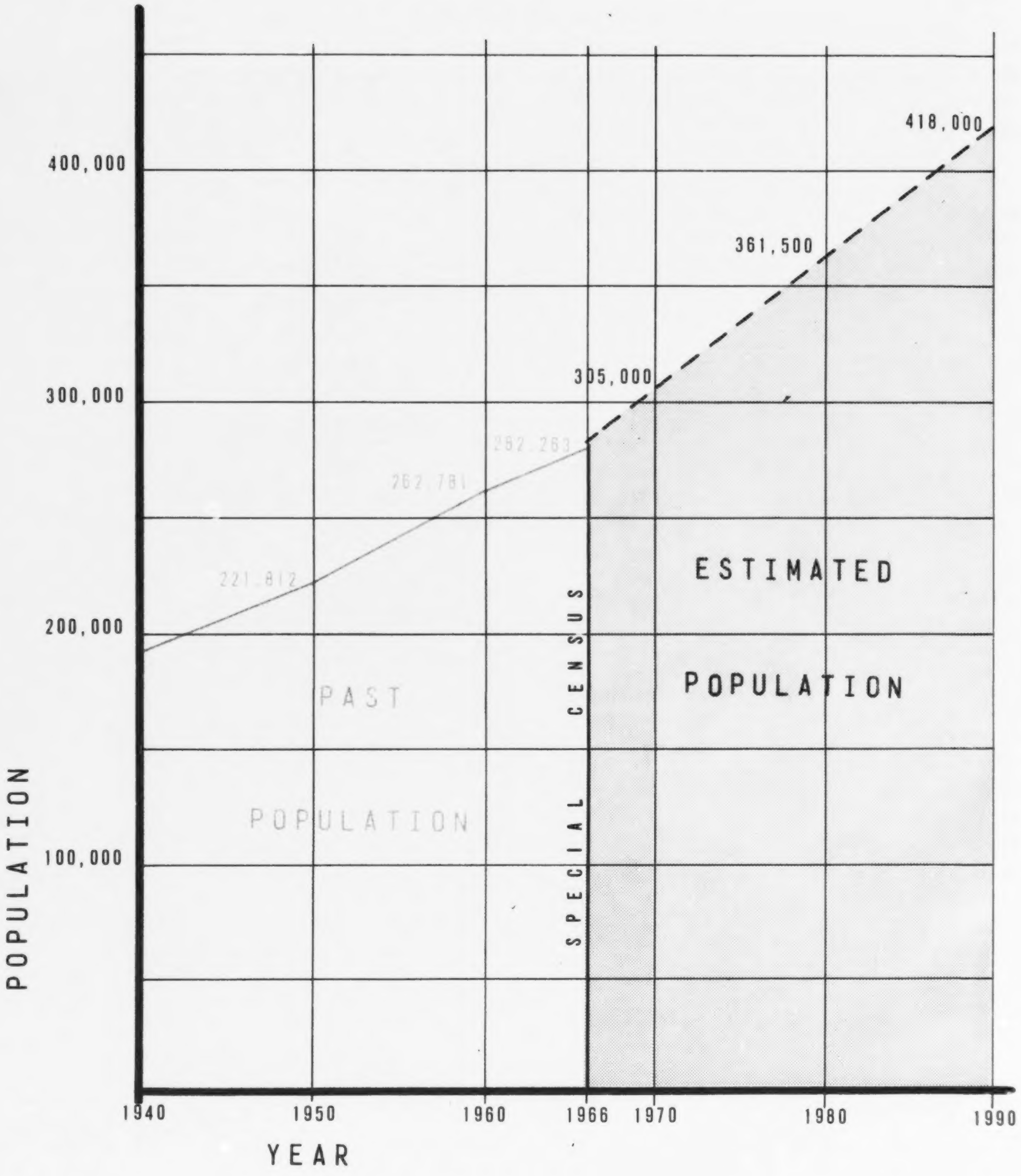
Table 1-3

1960 Household Data Solid Waste Study Area

	No. of Households 1960	Population per Household-1960
Altoona	401	3.54
Ankeny	837	3.54
Bondurant*	113	3.43
Carlisle	407	3.23
Clive*	222	3.40
Des Moines	68,226	2.99
Grimes*	211	3.30
Norwalk	376	3.53
Pleasant Hill*	112	3.54
Urbandale	1,495	3.89
West Des Moines	3,410	3.49
Windsor Heights	1,416	3.32
Polk & Warren Counties (part)	6,139	(Varies by Twp., from 3.14 to 3.94)

*Towns under 1,000 (1960) estimated using Township data.

Information shown in Table 1-3 has been upgraded to 1966 using Special Census information. This information has then been projected to 1990 for each individual city, town and township. Projections were based upon past trends, availability of land for new development, adjustments in family size, and long range land use projections for the area. Figure 1-5 shows the Study Area population from 1940 to 1966 with projections to 1990. Figure 1-5 indicates an average population increase of 5,650 persons per year, with an estimated 1990 population of approximately 418,000.



POPULATION TRENDS

FIGURE 1-5

Figure 1-6 shows the Study Area divided into three sectors based upon the natural division created by the Des Moines and Raccoon Rivers. 1990 population and dwelling unit estimates, along with past figures are shown for each sector of the Study Area. Total figures are also shown.

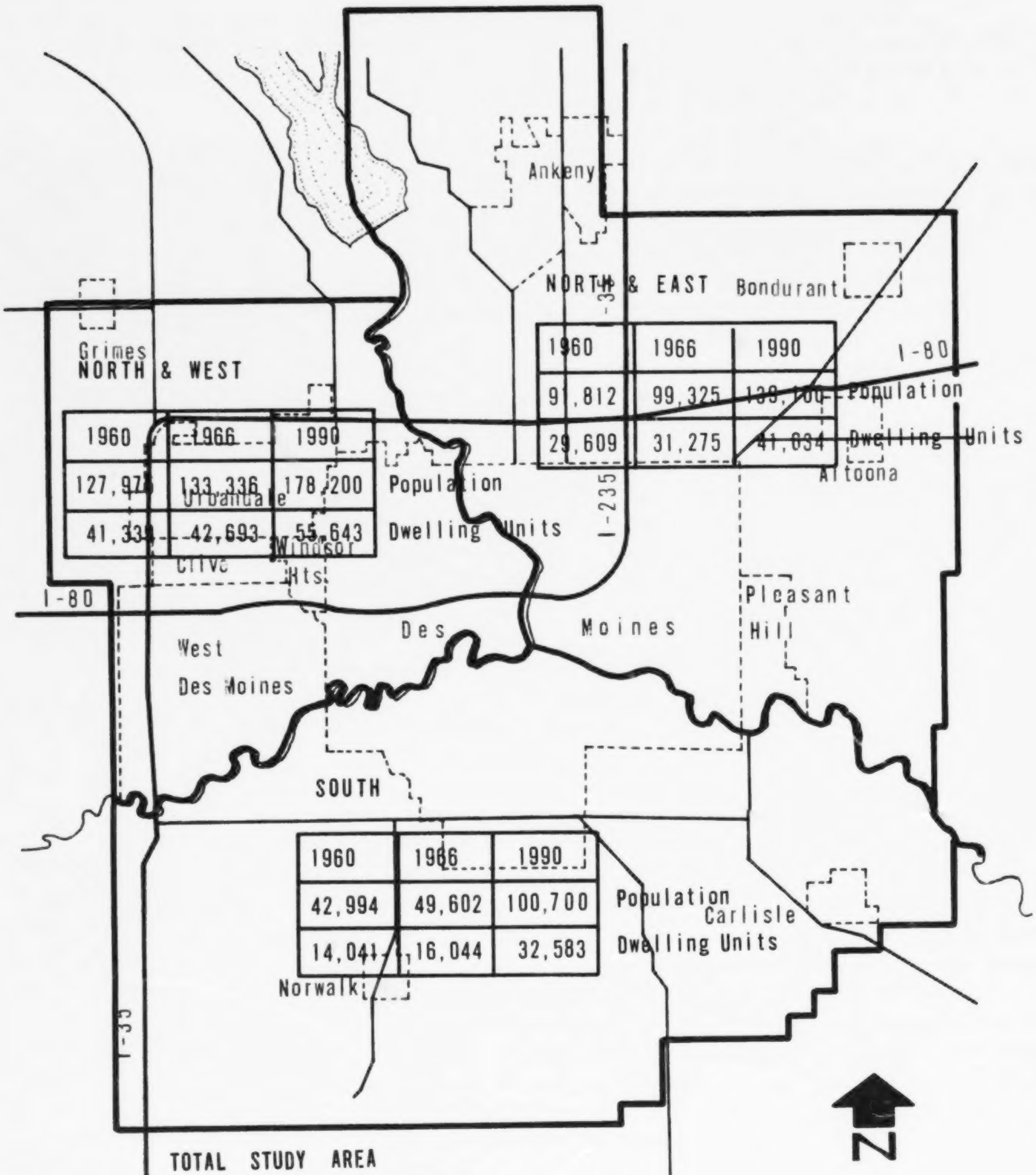
Figure 1-6 indicates that the north and west area will continue to be the most populous with an increase of about 45,000 by 1990. This area includes the heavy populated northwest part of Des Moines, which is practically 100 percent developed, along with the rapidly growing communities of West Des Moines, Clive, Windsor Heights and Urbandale. Most of the increase is expected to be in these communities and in the part of Webster Township north of Interstate 35 and 80.

The north and east area is expected to increase by approximately 40,000, with about 10% of this gain in northeast Des Moines.

This part of the City is also approaching the limit on available land for residential purposes. Ankeny, Altoona and Pleasant Hill, all rapidly growing communities, are expected to absorb most of the future population growth. Continued increases in the unincorporated townships north of Des Moines are also anticipated.

An increase of approximately 50,000 is shown for the south area. Much of this increase is expected in south Des Moines, and several private developments in Warren County that are presently planned or under construction. Norwalk and Carlisle, both of which have gained population rapidly in recent years also are expected to continue their growth patterns through 1990.

E. Land Use. Figure 1-7 indicates generalized land use projections for the Study Area by 1990. It should be emphasized that the land uses as shown are general in nature and are intended to represent major generators of solid waste, for which collection and disposal programs must be developed. Detailed land use studies are presently under way by the Central Iowa Regional Planning Commission, which is the official agency for regional planning in the Des Moines metropolitan area. The land use patterns shown represent the major concentrations of residential development, commerce and industry which are expected to have a measurable effect on the size and location of future solid waste disposal facilities.

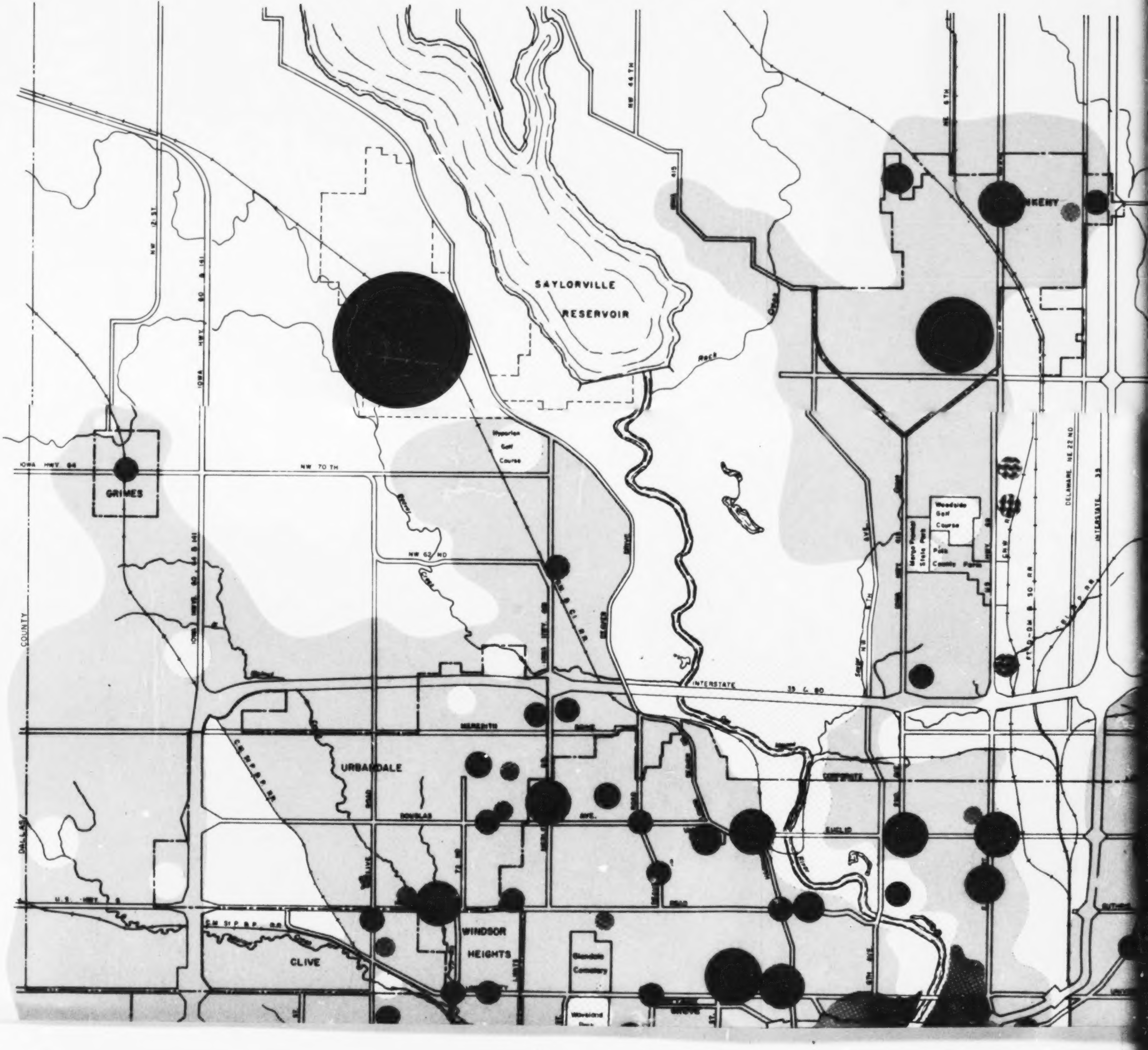

Ankeny
NORTH & EAST
Bondurant
1960
1966
1990
91,812
99,325
139,100
Population
29,609
31,275
41,034
Dwelling Units
I-80
I-35
I-235
Altoona
Grimes
NORTH & WEST
1960
1966
1990
127,975
133,336
178,200
Population
41,339
42,693
55,643
Dwelling Units
Urbandale
Clive
Windsor Hts
I-80
Pleasant Hill
Des Moines
West Des Moines
SOUTH
1960
1966
1990
42,994
49,602
100,700
Population
14,041
16,044
32,583
Dwelling Units
Carlisle
Norwalk
I-35
N

TOTAL STUDY AREA

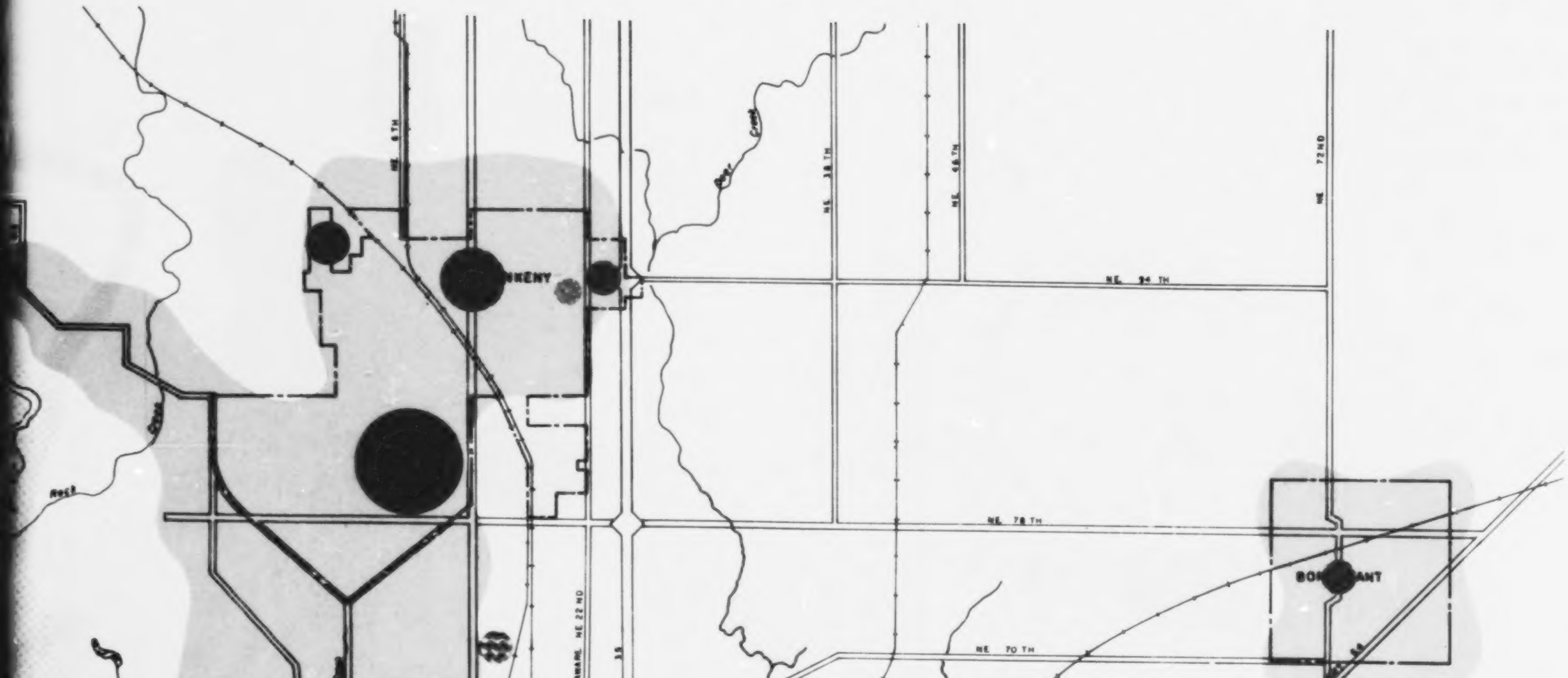
1960	1968	1990	
262,781	282,263	418,000	Population
84,989	90,012	129,860	Dwelling Units

POPULATION AND DWELLING UNIT DISTRIBUTION

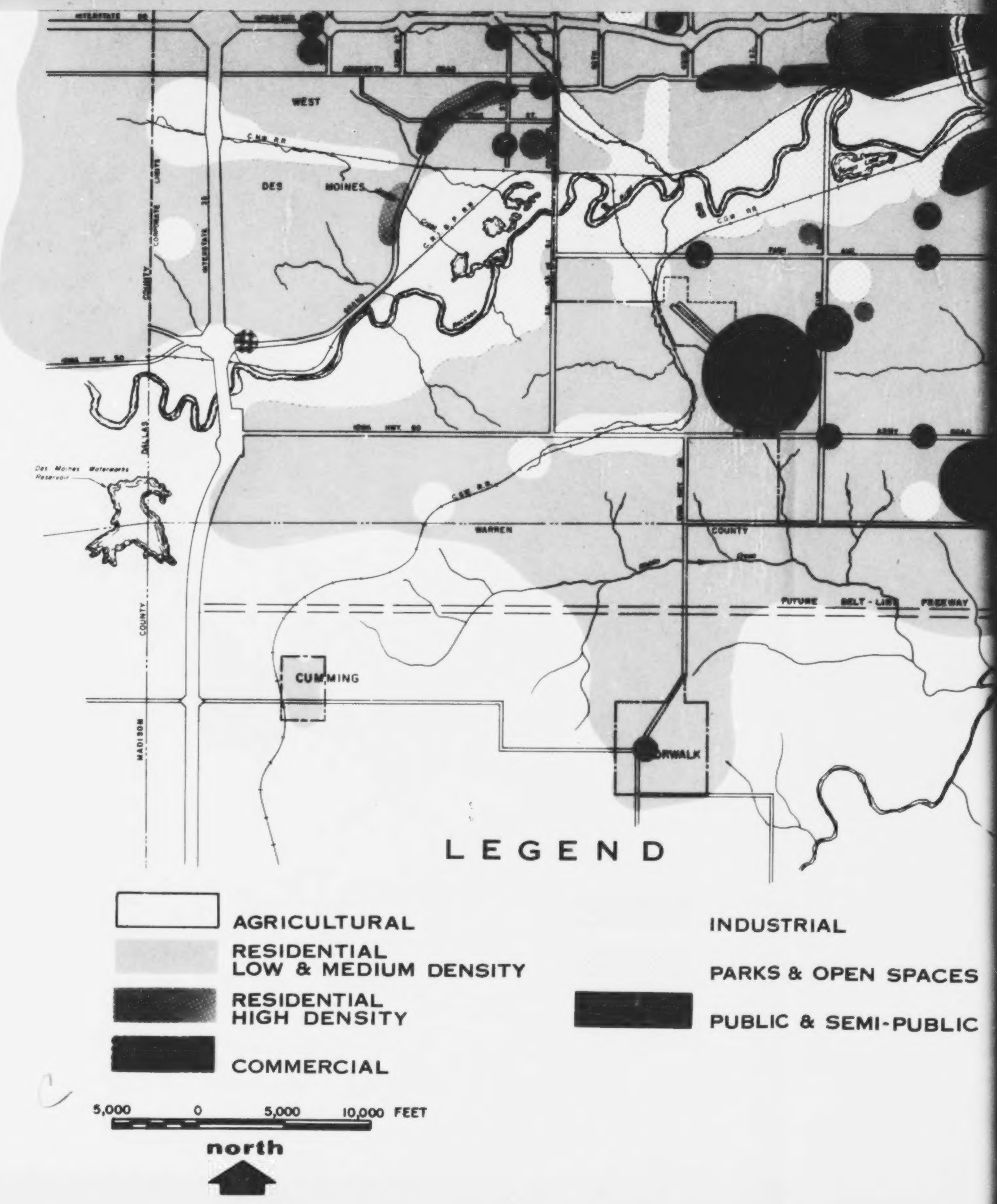
FIGURE I-6

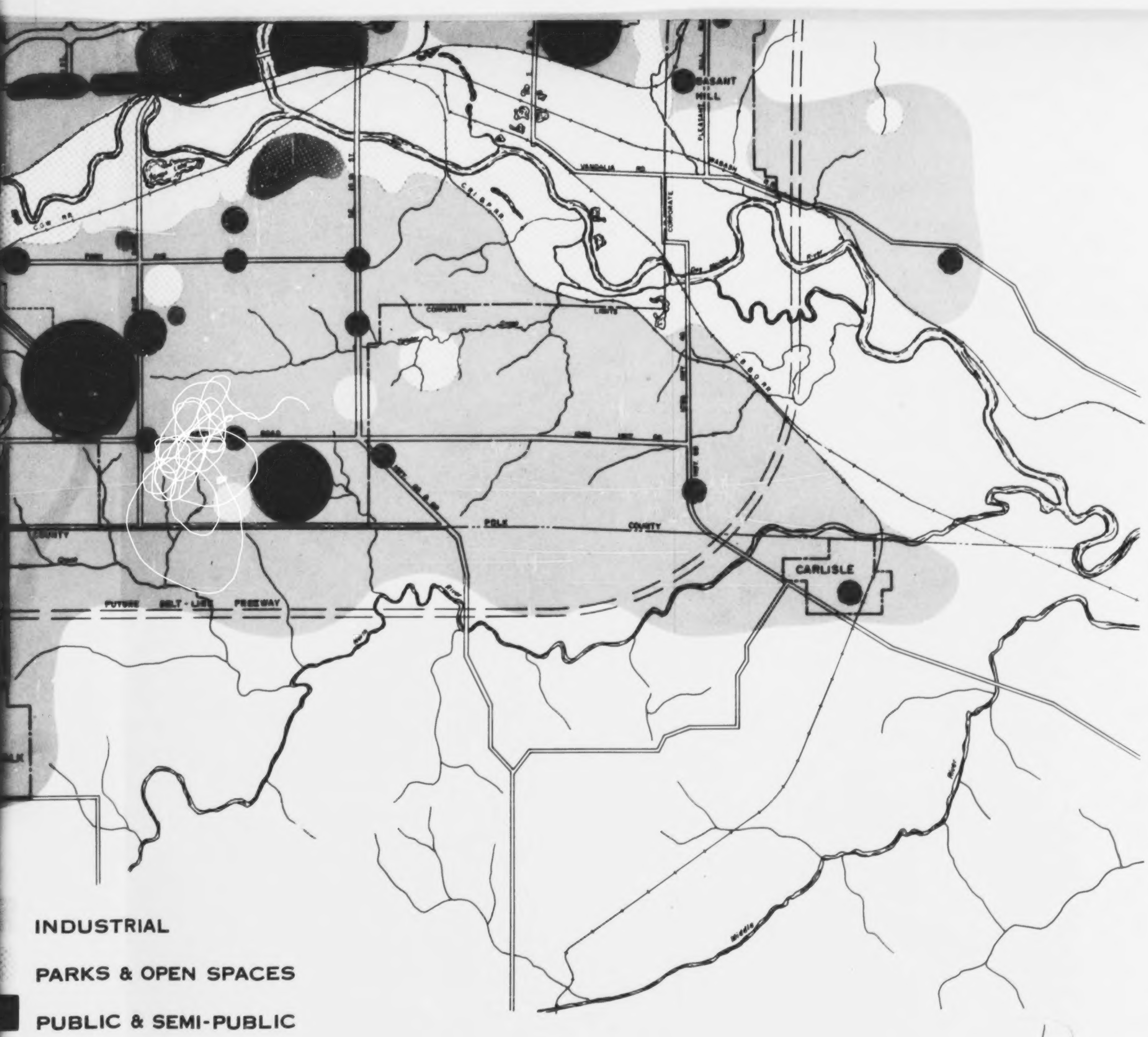

SAYLORVILLE
RESERVOIR
GRIMES
IOWA HWY 44
NW 70TH
NW 62ND
NW 44TH
IOWA HWY 141
Hyperion Golf Course
URBANDALE
MEREDITH
DOUGLAS
EUCLID
INTERSTATE 35 & 80
U.S. HWY 6
WINDSOR
HEIGHTS
CLIVE
Glendale Cemetery
Woodside Golf Course
Margo Frankel State Park
Polk County Park
DELAWARE NE 22ND
INTERSTATE 35
DALLAS
COUNTY
ANKENY

A


ANKENY
BONDURANT
ALTOONA
NE 6TH
NE 38TH
NE 56TH
NE 72ND
NE 94TH
NE 78TH
NE 70TH
Woodside Golf Course
Margo Frankel State Park
Polk County Park
DELAWARE NE 22ND
INTERSTATE 35
INTERSTATE 35 & 80
INTERSTATE 80
U.S. HWY 65 & IOWA HWY 64
CGW RR
CRI & P RR
BROADWAY
HWY 6
EUCLID
AVE
HUBBELL
GUTHRIE
UNIVERSITY AVE
HWY 163
NE 56TH

B


INTERSTATE 80
WEST
DES MOINES
C N W RR
COUNTY CORPORATE LIMITS
INTERSTATE 35
DALLAS COUNTY
IOWA HWY 90
Des Moines Waterworks Reservoir
C&W RR
WARREN
COUNTY
FUTURE BELT-LINE FREEWAY
CUMMING
NORWALK
MADISON COUNTY
ARMY ROAD
LEGEND
AGRICULTURAL
RESIDENTIAL LOW & MEDIUM DENSITY
RESIDENTIAL HIGH DENSITY
COMMERCIAL
INDUSTRIAL
PARKS & OPEN SPACES
PUBLIC & SEMI-PUBLIC
5,000
0
5,000
10,000 FEET
north


EASANT
HILL
VANDALIA RD
CORPORATE
LIMITS
POLK
COUNTY
CARLISLE
FUTURE BELT-LINE FREEWAY
INDUSTRIAL
PARKS & OPEN SPACES
PUBLIC & SEMI-PUBLIC

MAJOR LAND USES AS FUTURE SOLID WASTE GENERATORS

FIGURE 1-7

Approximately 50% of the replies contained complete enough information that they could be used in some way for estimating the quantities of on site disposal, and that which was removed to public facilities.

Personal Interviews. 87 firms were contacted either by phone or through personal visit to secure detailed information. These included large manufacturers, food processors, contractors, wholesalers, retail stores, office buildings, local government agencies and hospitals.

Information was obtained on the nature and quantity of waste, with emphasis on those wastes which are considered hazardous, contaminated, or otherwise require special handling in transfer and disposal operations. This included liquid wastes such as oils, solvents, paint, and ink which cannot be discharged to the sewer system.

All of the firms interviewed were evaluated as to type of process or product, nature of the waste, general magnitude of waste and method of disposal. Of the 87 firms interviewed, the data from 49 was considered complete and accurate enough to be used for estimating quantities of on site disposal and public disposal. See Exhibit 2-37 for sample form.

2. Waste Quantity. The firms contacted were categorized as to broad type of business activity and divided into general type of product or process for evaluating the quantities of waste generated. The following categories were used:

- I. Construction
  - A. Demolition.
  - B. Construction and General Contracting.
- II. Manufacturing
  - A. Food and Animal Feed Processing.
  - B. Dry Goods Manufacturing, Printing and Chemical Manufacturing.
  - C. Concrete Products, Brick and Tile Products, and Equipment Manufacturing.
  - D. Tire and Rubber Products
- III. Transportation and Public Utilities
- IV. Wholesale Trade
  - A. Dry Goods, Groceries and Equipment.
  - B. Agricultural.
- V. Retail Trade
  - A. All except grocery stores.
  - B. Grocery stores.

PART TWO - SURVEY OF SOLID WASTE

A. General. This Part of the report presents an analysis of the present and future quantities and characteristics of the solid wastes within the Study Area.

The study of existing solid waste materials was made in two parts. Part one was concerned with those materials which were being disposed of at public disposal sites in the Study Area. These materials represent more than 80% of the present quantities. Extensive site surveys were conducted at the six major disposal sites and are described in Section E of this part of the report.

The second part of the study concerned those materials which were being disposed of at places other than public disposal sites, referred to as "on site" disposal. The on site disposal includes those materials which in the future can be expected at public disposal facilities and those materials which will continue to be disposed of or accumulated on site. The on site materials were determined from commercial and industrial surveys described in Section B and through special studies.

Special studies were conducted to evaluate the wastes from junked automobiles, diseased trees, packing house solids, sewage solids, and the rubber industry. These studies are described in Section D.

B. Commercial and Industrial Surveys

1. Questionnaires. A survey was conducted to determine the nature and magnitude of wastes from various commercial and industrial firms in the area. The purpose of this survey was to determine if there were individual companies or types of companies with wastes that could have a significant effect on collection and disposal practice due to either the quantity of waste, or to the presence of wastes which are hazardous or otherwise difficult to handle at the disposal site, or had plans for significant changes in their waste. In addition, the survey provided data which could be used to supplement waste quantity information obtained from the landfill study. The firms surveyed were selected from a complete listing of industrial and commercial firms in the Study Area.

Mail Questionnaire. Two types of surveys were used to obtain this information. A mail questionnaire was sent to 211 companies requesting a general description of the types of waste, approximate quantity, current method of disposal, and whether the waste was considered hazardous. One follow-up letter was sent to firms which did not reply to the original mailing. Replies were received from 164 firms, or approximately 78% of those contacted. Where unusual or hazardous wastes were indicated, or where the questions were misinterpreted, a telephone call or a personal visit was made to secure additional information. A sample questionnaire form is reproduced in the Appendix as Exhibit 2-36.

VI. Finance, Insurance, Government and Miscellaneous Services

A. General Office & Government.
B. Hospitals.

Quantities of waste were estimated in most cases by plant or office managers. Most of the estimates were in terms of daily or weekly volumes with some weight information to assist in determining bulk densities for the various categories. The reliability of the estimates varied considerably. Smaller establishments generally estimated in terms of number and size of storage containers while in some larger firms, particularly manufacturers, the magnitude of the waste disposal operation necessitated more specific knowledge of quantities involved.

In order to establish a basis for relating the data obtained from the survey to the total waste generated in the Study Area, waste quantities were evaluated in terms of the number of employees in the individual firms contacted.

Following is a discussion of each of the individual commercial and industrial categories with the estimated waste quantity per employee. Quantity figures in terms of average daily pounds per employee are based on a full 7-day week.

I. Construction

A. Demolition. Includes demolition contractors and major demolition by general contractors and builders. 5 firms surveyed. Range; 13 to 2940 lb/employee/day. Average; 455 lb. /employee/day. Comment: Replies varied widely and were difficult to evaluate even in personal interview due to confusion between "waste" and "fill" materials. Number of employees not adequate basis for estimating total quantity of waste and therefore no estimate of total demolition waste was made from this source.

B. Construction and General Contracting. Includes general contractors, heating and air conditioning, electrical and plumbing contractors. 19 firms surveyed. Range 0.2 to 28 lb/employee/day. Average 3.1 lb/employee/day.

II. Manufacturing

A. Food and Animal Feed Processing. Includes meat packing, dairy products, canners, bottlers, flour mills and animal feed manufacturing. 21 firms surveyed. Range; 0.4 to 200 lb/employee/day. Average; 6.85 lb/employee/day. Comment: Paunch content and pen manure not included.

B. Dry Goods Manufacturing, Printing and Chemical Manufacturing. Includes manufacturers of clothing, furniture, paper products, paints, drugs, and printers and publishers. 21 firms surveyed. Range 0.2 to 57 lb/employee/day. Average: 6.55 lb/employee/day.

C. Concrete Products, Brick and Tile Products, and Equipment Manufacturing. Includes cement manufacturing, concrete products, clay products, machinery and equipment manufacturing, and steel fabricators. 18 firms surveyed. Range; 0.6 to 192 lb/employee/day. Average; 9.70 lb/employee/day. Comment: Broken concrete products included but not slag from manufacture of portland cement.

D. Tire and Rubber Products. Includes scrap tires, rubbish and miscellaneous rubber products from manufacturers of tires. 2 firms surveyed. Average; 28 lb/employee/day.

The average for all manufacturing in the Des Moines metropolitan area was 12.45 lb/employee/day.

III. Transportation and Public Utilities. Broad category including public carriers, public communications and utilities. 5 firms surveyed. Range; 0.3 to 1.7 lb/employee/day. Average; 0.53 lb/employee/day.

IV. Wholesale Trade

A. Dry Goods, Groceries and Equipment. Includes wholesalers of food, drug and paper products, equipment companies and other suppliers. 16 firms surveyed. Range; 1.6 to 65 lb/employee/day. Average; 15.6 lb/employee/day.

B. Agricultural. Includes livestock and grain dealers. 4 firms surveyed. Range; 1.3 to 1800 lb/employee/day. Average; not applicable. Comment: Insufficient number of firms to establish a meaningful average. Livestock dealers included pen cleanings which annually averaged 1000 to 1800 lb/employee/day.

V. Retail Trade

A. All except Grocery Stores. Includes lumber, general merchanidse, automotive, apparel, furniture, drugs, eating places and hotels and motels. 17 firms surveyed. Range; 1.3 to 23 lb/employee/day. Average; 5.05 lb/employee/day.

B. Grocery Stores. 4 stores surveyed. Range; 12.1 to 23.1 lb/employee/day. Average; 19.0 lb/employee/day.

The average for all retail trade in the Des Moines metropolitan area was 7.35 lb/employee/day.

VI. Finance, Insurance, Government and Miscellaneous Services

A. General Office and Government. Includes general office buildings, government offices, and miscellaneous services not directly connected with other commercial and industrial categories. 6 buildings surveyed. Range; 1.3 to 1.8 lb/employee/day. Average; 1.6 lb/employee/day.

B. Hospitals. 3 surveyed. Range; 3.0 to 6.5 lb/employee/day. Average; 3.9 lb/employee/day.

3. Total Industrial - Commercial Waste. Present industrial and commercial wastes were projected using the data obtained from the survey, employment statistics from the 1963 Census of Business, U. S. Department of Commerce and information published by the Iowa Employment Security Commission. Projections were made for each of the categories listed in the preceding paragraph. Table 2-1 sets forth the estimated present quantities of waste in both cubic yards per day and tons per day, and gives the percentage surveyed of the total employment in each category. A high percentage of the manufacturing group was surveyed, approximately 61 percent of total employment in that group. For all groups, approximately 20 percent of the total non-agriculatural employment in the metropolitan area was included in the survey.

In order to establish the amount of present and future on site disposal the quantities have been tabulated as to (1) material disposed of at public sites, (2) material disposed of on site, including incineration and private landfilling, (3) total quantity of waste generated, and (4) material expected to remain as on site disposal after air pollution control and landfilling regulations have been put into effect.

The total industrial-commercial waste to public disposal sites projected from the survey is somewhat less than determined from the landfill survey described in Section E. The 320 tons per day, or 117,000 tons annually, to public disposal sites, is 78.5% of the 149,000 tons annually, estimated from the landfill survey. The landfill survey is considered a more reliable estimate, since it is based on actual measurement of waste volumes over a weeks operation at each of the major public landfills. The lower values determined from the industrial-commercial survey may be due to a number of factors, including a tendency for the firms to underestimate their quantity of waste, a relatively small base from which to project quantities in some categories, and possible inaccuracies in projecting waste quantities based on employment.

Although a close correlation could not be made between the two surveys, the industrial-commercial survey did meet the primary objectives. A comparison was established between public disposal and present and future on site disposal. Materials considered hazardous or otherwise troublesome to handle were delineated and, in addition, valuable data was developed on the approximate waste quantities generated by various types of industrial and commercial activities.

TABLE 2-1

INDUSTRIAL-COMMERCIAL SOLID WASTE DISPOSAL, DES MOINES METROPOLITAN AREA

	PER CENT OF GROUP SURVEYED	ESTIMATED 1967 EMPLOYMENT	MATL. TO PUBLIC DISPOSAL		MATL. TO ON-SITE DISPOSAL		TOTAL QUANTITY		CONTINUED ON-SITE DISPOSAL	
			CY/ DAY	TON/ DAY	CY/ DAY	TON/ DAY	CY/ DAY	TON/ DAY	CY/ DAY	TON/ DAY
1. CONSTRUCTION										
A. DEMOLITION										
B. CONSTRUCTION AND GENERAL CONTRACTING	7.9	5,300	60	7	24	2	84	9	0	0
TOTAL	7.9	5,300	60	7	24	2	84	9	0	0
2. INDUSTRIAL										
A. FOOD AND ANIMAL FEED PROCESSING	52.9	3,650	87	11	23	2	110	13	0	0
B. PRINTING, DRY GOODS AND CHEMICAL MANUFACTURING	54.6	8,090	381	24	21	2	402	26	0	0
C. CONCRETE, BRICK, TILE, AND EQUIPMENT MANUFACTURING	61.4	8,710	256	34	168	8	424	42	0	0
D. TIRE AND RUBBER PRODUCTS	97.1	4,050	326	57	0	0	326	57	0	0
TOTAL	61.1	24,500	1,050	126	212	12	1,262	138	0	0
3. TRANSPORTATION AND PUBLIC UTILITIES	26.9	8,400	31	2	0	0	31	2	0	0
4. WHOLESALE TRADE										
A. DRY GOODS, GROCERIES AND EQUIPMENT	7.0	11,700	426	89	30	2	456	91	0	0
B. AGRICULTURAL	7.4	350	12	3	11	7	23	10	0	0
TOTAL	7.0	12,050	438	92	41	9	479	101	0	0
5. RETAIL TRADE										
A. ALL EXCEPT GROCERY STORES	6.9	15,800	592	42	32	2	624	44	0	0
B. GROCERY STORES	9.2	2,550	88	11	272	13	360	24	220	11
TOTAL	7.8	18,350	680	53	304	15	984	68	220	11
6. FINANCE, INSURANCE, GOVERNMENT AND MISCELLANEOUS SERVICES										
A. GENERAL OFFICE AND GOVERNMENT	5.3	45,850	652	36	18	1	670	37	0	0
B. HOSPITALS	37.6	4,000	58	4	75	4	133	8	45	2.5
TOTAL	7.9	49,850	710	40	93	5	803	45	45	2.5
TOTAL OF ALL GROUPS	20.1	118,450	2,969	320	674	43	3,643	363	265	13.5

NOTE: 1. PER CENT OF GROUP SURVEYED IS PORTION OF TOTAL EMPLOYMENT IN INDIVIDUAL CATEGORY WHICH WAS COVERED BY THE SURVEY.

2. ESTIMATED 1967 EMPLOYMENT IS TOTAL NON-AGRICULTURAL EMPLOYMENT IN THE DES MOINES STANDARD METROPOLITAN STATISTICAL AREA.

3. CUBIC YARDS ARE LOOSE VOLUME AS STORED ON PREMISES.

4. SEE PART II, PARAGRAPH B FOR EXPLAINATION OF TERMS.

Inspection of the total waste quantities developed from this study show that present on site disposal amounts to approximately 13% by weight of that which is delivered to public disposal sites. Estimates of future on site disposal correspondingly amount to 4% of that disposed of at public sites. The difference, of approximately 9% on a tonnage basis, represents the estimated increase in public disposal of industrial-commercial solid wastes due to upgrading of incineration standards and effective control of private dumping. On a volume basis, present on site disposal is somewhat greater, 23% of that disposed of at public landfills, and the estimated future on site disposal is approximately 9% by volume.

4. Conclusion. Although the industrial-commercial survey revealed only about 80% of the annual solid waste tonnage from this activity compared to the landfill survey, the industrial-commercial study did provide valuable information concerning the magnitude of waste generated by these activities. Also the survey produced what can be considered a reasonable estimate of on site disposal in terms of percentages of that disposed of at public sites, for both the present and the future.

Special and hazardous waste materials revealed by the survey are discussed in subsequent paragraphs. Although a few types of waste require special handling in storage, transfer and disposal operations, no single industry or type of industry produced waste materials of a magnitude to significantly affect the disposal methods considered.

C. Residential Survey. The existing practice in all of the communities in the Study Area is to collect, or encourage the collection of residential garbage, generally referred to as domestic kitchen waste. No community provides collection of other than domestic kitchen waste and none actively encourages collection of other than the domestic kitchen waste by private haulers. All permit the burning of domestic combustible rubbish. Some communities have regulations concerning burning, however little evidence is available to support effective enforcement. The usual practice is to burn combustible rubbish in old oil drums or burning barrels. It has been observed that domestic kitchen wastes are often burned with the combustible rubbish. There is no regular collection of residue from the burning barrels. The common practice is to have commercial haulers remove residue from time to time as needed, when collecting non-combustible rubbish and bulky wastes. In some cases, the residue and non-combustible trash is allowed to accumulate on site. Fortunately, this practice is not common, and what is left on site does not represent a significant quantity for concern in this study. On site accumulations should be discouraged, regardless of the quantity, for reasons of general public health and elimination of blight.

Domestic kitchen waste is usually collected on a once a week basis, either by the municipalities or private haulers. This material was measured during the landfill surveys. The residue from burning and non-combustible refuse hauled to the disposal points was also measured during the landfill survey. The portion which was not measured is that portion of the domestic wastes which was burned on site.

It was anticipated that certain residences would be selected from the Study Area and all of the domestic wastes would be collected from these residences as an experimental group. A comparison would be made between the waste quantities collected from the experimental residences, and the kitchen wastes of the remaining control group. Problems were encountered in obtaining controlled conditions for the remainder of the community with which the experimental quantities would be compared. These problems are described in Part Three, Section E. Because the total domestic waste quantity is only a small part of the total solid wastes of the community, and because it is possible to estimate the total per capita domestic waste based on other cities in the same geographic region where the quantities are known, it was decided to use estimates of the additional domestic waste now being disposed of on site.

The study of the total quantity of all domestic waste was not abandoned. It was decided to reorganize the collection procedures and then convert several entire collection routes to the collection of all domestic wastes, as opposed to garbage only. Data concerning the reorganized controlled collection of kitchen waste and parallel experimental data from collection of all domestic waste has been planned and described in Part Three, Section E. The details concerning this approach are explained in a letter to the U. S. Public Health Service, dated November 1, 1967 and included in the Appendix as Exhibit 2-1. This approach was approved in a letter from the U. S. Public Health Service dated December 13, 1967.

253,000 cubic yards per year could be expected if all domestic waste was collected. Since 173,000 cubic yards per year was measured, it is estimated that the additional amount to be collected, if all domestic waste was collected, is equal to 80,000 cubic yards per year or 15,000 tons.

D. Special Studies

1. General. During the organization of this study, it was recognized that there were several special waste problems which could influence present and future planning. These special wastes, though common to communities, can present unusual collection and disposal problems. Individual studies were conducted and analyzed to determine the influence they would have on the solid waste program for the area. These special wastes discussed in the following paragraphs include automotive vehicles and the related salvage industries; tree wastes caused by Dutch Elm disease; packing house wastes; sewage solids; and rubber industry wastes.

2. Automobiles and Scrap Metal

a. General. Abandoned automobiles, auto salvaging and scrap metal operations were studied to determine the extent of the solid waste involved. It was found that they do not present a solid waste problem of any significant magnitude, although they do present many other community problems. It was also found that the auto salvaging and scrap metal industries are not understood by the general public. In the following paragraphs, data is given to explain the function of these industries, the problems they create, what can be done about the problems and why they do not create solid waste in any large quantity.

b. The Auto Salvage Industry. The motor vehicle is a vital part of our society affecting the general economic structure and life of the community. The motor vehicle has a definite life cycle. Based on national averages, the motor vehicle survival rate is as follows:

Years after Original Registration	Percent of Vehicles Surviving
6	95
8	81
10	56
12	33
14	18

During its life cycle the motor vehicle will pass from a transportation unit to a valuable source of materials, providing spare parts for other units still operable. Eventually it becomes a natural resource of scrap metals to be used by the metal making industries.

Information from automobile manufacturers and the salvage industry reveals the average total weight for an automobile is about

3,300 pounds, of which 600 pounds, or 18%, is not savable metal, such as upholstery, rubber mats, tires, hoses, insulation, undercoating, glass and plastics. The balance of the weight is composed of various kinds of ferrous metals and non-ferrous metals, such as copper, zinc, aluminum, lead, brass bronze and others.

The auto salvage industry has been historically identified as the "junk yard," which it is not. It deals in the salvaging of reusable parts for the automotive industry. Unsalvable or obsolete parts are sold to the scrap metal industry.

With the tremendous and continuing increase of automobile production over the years, the auto salvage industry provides a needed service to the community. The 1985 predicted motor vehicle population of the United States is estimated at 115 million. A damaged automobile, economically unrepairable, can provide many valuable and serviceable spare parts, including partial body sections, for the repair of other less damaged vehicles.

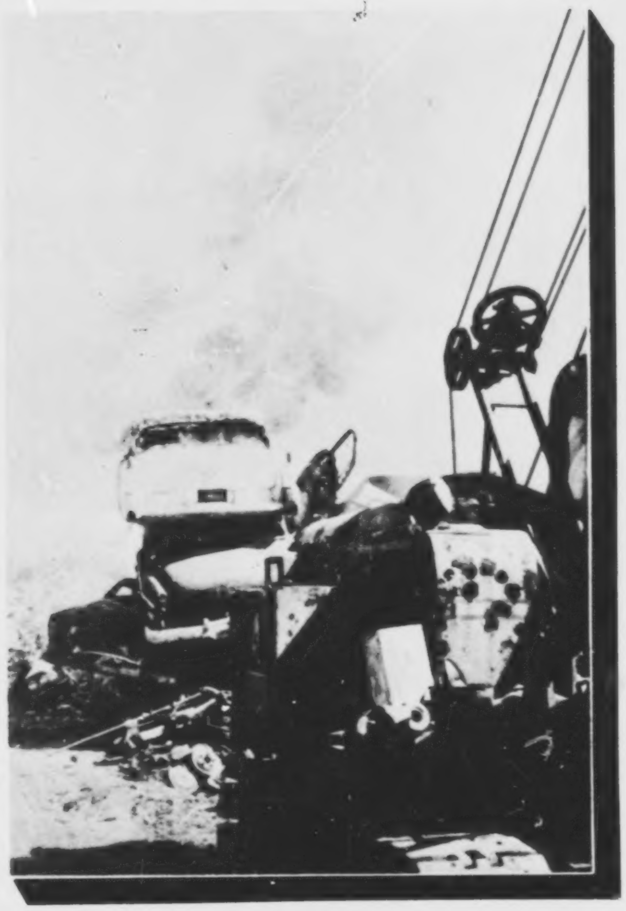
This industry has a well deserved, bad reputation for aesthetic conditions. Fig. 2-1 shows typical conditions observed during the survey. Recent Federal legislation in the form of the Highway Beautification Acts, provides certain regulation concerning "Auto Wreckers" near or adjacent to Federally Funded Highways, and has brought much attention to the industry. These regulations require certain fencing and screening of the operations under prescribed conditions. However, this does not apply to many auto salvage operations in urban areas which must be controlled by zoning laws or other ordinances. The auto salvager usually operates in an industrial zone, or similar area through the legality of zoning variances.

The salvager normally maintains a large and unsightly stockpile of auto hulks, all potential items of solid waste. When the auto has been stripped of all possible spare parts, it is ready for the conversion to scrap metal. Most scrap metal processors of auto hulks insist they be burned to rid them of all non-metallic material before they will be accepted as scrap metal. This requirement is more of an accepted practice than an absolute necessity. It makes the metal processor's job easier and reduces his costs. The open burning of auto hulks is a nuisance to the community, a source of air pollution and a fire hazard. Fig. 2-2 shows typical burning conditions observed during the survey. Passage and strict enforcement of anti-burning laws are necessary to curb this practice. Auto hulks can be processed for metal salvage without burning and are processed this way in many communities. Elimination of burning will create additional costs to the industry; however this is a problem for the industry to overcome as a part of doing business.

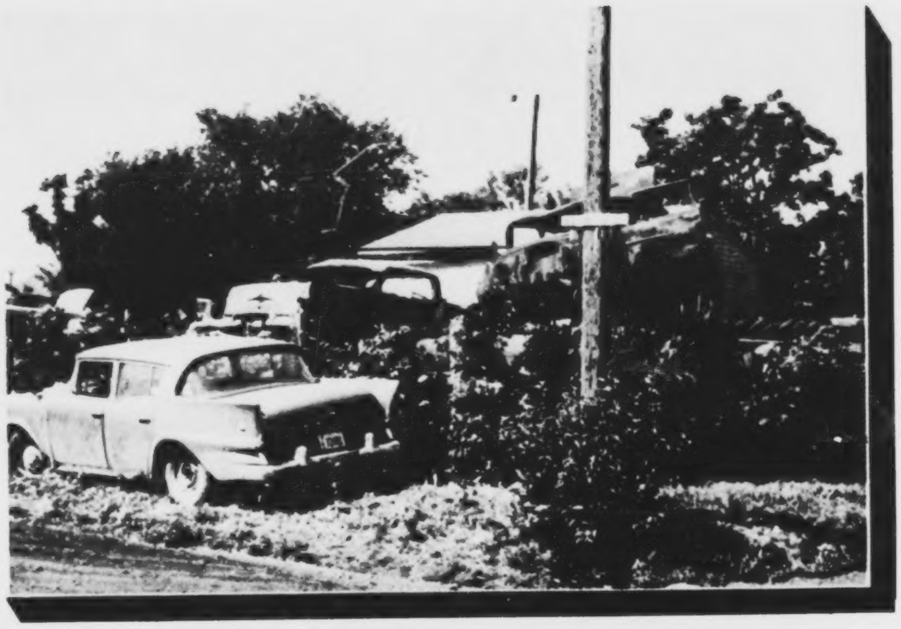
The problem of large inventories of auto hulks is a problem the salvage industry has, and will continue to have as long as scrap metal prices remain at the present low level. New metal making methods have lessened the demand for scrap metal and consequently the price has been substantially effected. Many salvagers stockpile auto hulks hoping for future price increases, and move out some hulks only to make room for newer models.

● Typical Scenes of Automobile Salvage Operations Observed in the Study Area.

FIGURE 2-1



● Typical Auromobile Salvage Burning Operation Observed in the Study Area.



● Automobile Salvage Operation and Hulk Storage on a Public Right of Way Observed in a Residential Section of the Study Area.

FIGURE 2-2

The survey included 25 salvage yards in the Study Area and revealed an estimated 10,280 hulks on hand. Operators estimated that approximately 37% of all vehicles on hand would be disposed of with an appreciable increase in the price of scrap metal. The yards surveyed occupied approximately 109 total acres, an average of about 108 vehicles per acre.

In general, the housekeeping practices of the auto salvage industry are poor, contributing to the public demands that something be done to clean up this industry. Part of the problems are inherent in the nature of the work. Salvage yards are difficult to maintain in an acceptable and nuisance-free condition, but it can be done. A few of the operators have made attempts to screen their yards and present a decent appearance. They would do more if the industry was required to conform to currently existing ordinances and zoning regulations. Although many hulks are retained in hopes of improved scrap prices, many accumulate simply because it costs more to load and haul the hulks to the metal salvager than they are worth. The stripped hulk at this stage is an industrial waste to the auto salvager. By allowing the hulks to accumulate, he is postponing the expense of disposal. If he were required to site screen his yard and control the weeds and insect breeding conditions around these old hulks, more of them would be promptly removed to the scrap metal dealer.

The auto salvage industry in the Study Area has a potential solid waste problem in the large inventory of auto hulks. This potential will not become a problem of disposal to the community while there is a market for the scrap metal. Even though it may cost the salvager more to haul the hulk to the scrap dealer than he is paid for the hulk, it is more economical than hauling the hulk to a municipal disposal site and receiving nothing or being charged to dispose of it.

Strict enforcement of ordinances in the Study Area pertaining to operating conditions in and around salvage establishments is necessary to improve aesthetic conditions and reduce the health and fire hazards for the community. Enforcement of these regulations may cause a temporary surge of auto hulks onto the local scrap market, but we believe this would be a minimal problem. Some minor costs to the salvager will result, but this must be considered as a cost of doing business.

The auto salvage industry plays an important role in the community. However they must be required to conduct their business in such a way that it will not interfere with the welfare of others.

Table 2-2

Auto Salvaging Industry Statistics

Sampling Group:

Auto salvage operations observed and interviewed: 24 (20 within City of Des Moines).
Estimated total wrecked vehicle inventory on hand: 10,280
Estimated number 1960 or older wrecked vehicles on hand: 3,293
Estimated total acres occupied by Salvagers, Study Area: 108.5
Estimated wrecked vehicles per acre, on hand: 108
Estimated source of wrecked vehicles: Dealer, including impounds: 1060(9.8%)
Individuals: 6455 (58.5%)
Insurance Co.: 3305 (30.5%)
Estimated hulks immediately available from current inventories, with improved market conditions: 3060 (37.5%)

Study Area:

Estimated current monthly scrapping rate: 600 vehicles.
Estimated 1967 vehicle registration: 124,000
Estimated yearly scrapping rate, Study Area: 6% of registration
Estimated yearly scrapping rate, Nation: 7% of registration
Estimated average net increase in yearly registration, Study Area: 3%
Estimated average net increase in yearly registration, Nation: 3%
Estimated rate of vehicle registration and scrapping, Study Area:

	Registration	Scrapping @ 6%
1968	127,700	7,662
1969	131,500	7,890
1970	135,400	8,124
1971	139,000	8,340
1972	143,200	8,592
1973	147,500	8,850
1974	151,900	9,114
1975	156,500	9,390
1976	161,200	9,672
1977	166,000	9,960

Estimated Total Scrapped Vehicles, 1968 - 1977: 87,594

c. Scrap Metal Industry. The scrap metal industry is responsible for the final phase in the life cycle of the automobile and the source of other salvaged metals before they are reclaimed in new metal making processes. This industry has provided over 40 million tons per year of scrap metal for metal making industries and foreign exports. Over 40% of the nation's copper and more than 1/2 million tons of lead is recovered annually by the scrap metal industry. The automobile hulk accounts for about 5 million tons of metal per year.

This industry experiences many of the same problems outlined for the auto salvagers. Large stockpiles of processed scrap are often on hand due to the lack of demand for the product. Large and expensive machinery is required to process the metals and auto hulks and the operation is seldom confined within buildings.

There are two major scrap processors in the Study Area; one is considerably larger than the other. Both concerns are located in industrial zoned areas and make reasonable attempts to keep their operations inoffensive. One deals mainly in automobile hulks and the other processes all types of scrap. The price paid for auto hulks and other scrap metals is governed by the demands of the basic metal industry and the prices they in turn will pay.

Recent innovations in the steel making process has caused the local scrap metal dealers to ship their product to out-of-town processors who have equipment capable of shredding the scrap to small pellet size pieces. Although the end product brings a better price, the local price is lower.

Under present and foreseeable conditions, the automobile hulk problem in the Study Area can be handled by local scrap dealers.

The passage of anti-burning laws will present some operational problems to this industry, but it is doubtful that they will stop processing auto hulks because of this.

d. Abandoned Automobiles. The present problem of abandoned automobiles in the Study Area does not appear to be large. Most old and unserviceable vehicles find their way to the scrap metal dealers.

Unserviceable or abandoned automobiles on private property are considered the problem of the property owner. If abandoned on a public street or property, the City will haul it away, impound it, and attempt to locate the last registered owner. If located, the last registered owner is responsible for any cost incurred during impoundment. Periodically the impounded vehicles are auctioned to the highest bidder. Impound costs are deducted from the bid price and the balance, if any, is sent to the last registered owner, if he has responded to the previous notice. Where no owner can be found, auction proceeds are retained by the City. In 1966 only 344 abandoned vehicles were auctioned.

The identification of abandoned automobiles is difficult under the present system; however the State Motor Vehicle Department registration system is undergoing a change. If a method of cross-referencing licensing, motor and body numbers is put into effect, most vehicles will be easily traced to the last registered owner.

The present handling of abandoned vehicles in the Study Area is generally adequate considering that few vehicles are involved. Abandonment may increase if salvagers become reluctant to receive vehicles too old for parts or salvage value, if new operating regulations are enforced. However, it is believed this would not be a serious problem. Improved vehicle identification methods, strong enforcement, and proper penalties for abandonment of vehicles, should control any increase.

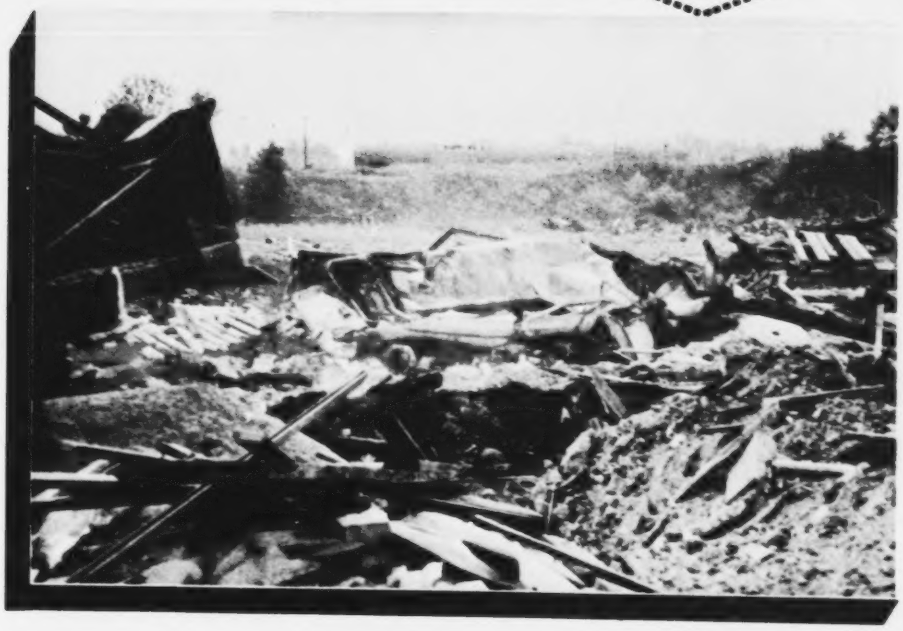
e. Automobile Disposal by Municipalities. With the increasing cost of processing of auto hulks, and the passage of air pollution regulations, it is possible that salvagers will be reluctant to receive or pay for hulks for scrap purposes.

If this were to happen, it is possible to dispose of auto hulks in landfills. During this study an experiment was conducted at a municipal disposal site to determine what volume would be required for an average hulk. A 1957 medium priced station wagon, including upholstery, frame and heavy undermetal, but excluding the engine block, bumpers, wheels and tires; a typical abandoned auto type, was placed right side up on level ground. A landfill bulldozer was used to crush the hulk. The operation took approximately five minutes, reducing it in volume from about 432 cubic feet to less than 108 cubic feet, or 4 cubic yards. Fig. 2-3 shows this experiment. The compacted hulk was easily included with other waste and covered with earth. This is a poor ending for a proven natural resource, but indicates disposal by landfilling is practical.

f. Laws and Regulations. The auto salvage and scrap metal operation, and the abandoned vehicle are technically not a solid waste problem. They are; however, a community problem requiring proper control insofar as they affect the health, safety and well being of the community. Existing ordinances and regulations are not adequate for several reasons. In some instances, they are unrealistic and consider auto salvaging, the scrap metal industry, junk yards and pawn brokers as being the same. Each are different and should be treated separately. Some requirements are not practical and if enforced would require unwarranted expense not only to the industry but to the municipality. In other cases, there are inadequate requirements to protect the public. As a result there is little effective enforcement of existing laws and regulations.

The municipal code of the City of Des Moines was reviewed in those chapters where the problems discussed in this section of the report are involved. This code was selected for review because Des Moines

Scenes Depicting the Experiment Reducing an Automobile Hulk to a Minimal Volume by Crushing with a Landfill Bulldozer. The Crushed Hulk can be Buried with other Waste in a Sanitary Landfill.



The bulldozer shown in these scenes is a Caterpillar D-7.

FIGURE 2-3

is the largest city in the Study Area and has the most comprehensive code. It is not the intention to rewrite any particular provisions. This is the function of the municipal authorities. However, the following is a list of suggestions we believe should be considered.

Specific Des Moines City Ordinances Reviewed

Chapter 2A	Zoning; Sections 2A-1 through 2A-39.
Chapter 3A	Anti Litter.
Chapter 20	Fire Prevention Code; Article III - Automobile Wrecking Yards, Junk Yards and Waste Material Handling Plants; Section 20-31 through 20-35.
Chapter 26	Junk Dealers; Sections 26-1 through 26-19.
Chapter 30	Motor Vehicles & Traffic; Article XIV - Penalties, Procedure Upon Arrest and Impounding; Sections 30-867 through 30-885.
Chapter 39	Police Department; Sections 39-6 (Duty to Enforce Laws, Ordinances, etc.); 39-9 (Power to Arrest); 39-10 (Service and Execution of Warrants and Other Process).
Chapter 46	Rat and Pest Control; Article I - Ratproofing; Sections 46-1 through 46-17.
Chapter 51	Smoke Abatement; Article I - In General; Sections 51-1 through 51-11; Article II - Construction, etc. of Combustion Units for Production of Heat or Power; Sections 51-12 through 51-23.

In all the ordinances, it is suggested that specific definitions and categories be established for each of the following subjects, in lieu of the general subject "Junk Yards."

1. Auto Salvage and/or Wrecking Yards.
2. Scrap Metal Processing Yards.
3. Junk Yards.

Although all the subjects deal in salvable or reclaimable items, in a broad general sense, each has particular and specific problems.

Chapter 2A - Zoning. The continued restriction of these industries within the M-2 (Heavy Industrial) Zones is recommended.

Chapter 3A - Anti Litter. This chapter should be revised to specifically prohibit the accumulation or storage of inoperative vehicles on private property in residential neighborhoods, unless the vehicle is properly garaged. Such vehicle accumulation or storage can be considered "litter."

Chapter 20 - Fire Prevention Code; Article III - Automobile Wrecking Yards, Junk Yards and Waste Material Handling Plants; Sections 20-31 through 20-35. It is suggested that the Section on Location (20-32) should include reference to weed and foliage control as a means of reducing brush fires. Also suggested is reference to specified type of free and clear accessibility to all structures and inventories retained in open yards with regard to fire fighting personnel and equipment. It is recommended that Section 20-35 (Burning Operations) be deleted and all open burning be prohibited.

Chapter 26 - Junk Dealers; Sections 26-1 through 26-19. This chapter in particular should be rewritten with the earlier suggestion of a clear definition for the three industries concerned. Section 26-10 (Records) requires that all industries, under the heading of "Junk Yards," must maintain a record book containing names, addresses, particulars, weight and description of all transactions. The Auto Salvager should be required to have only a record of legal acquisition of the auto through the use of title transfer and receipt from the Motor Vehicle Licensing Authority indicating the vehicle has been cancelled from the State rolls for salvage purposes. The scrap metal processor should be deleted completely from this requirement when purchasing from sources such as the properly licensed auto salvager. Similarly, Section 26-11 (Report to Chief of Police), requires the present general category of "junk yards" to report, in writing, a wide and varied selection of listed items to the Chief of Police within 24 hours of acquisition. If properly enforced, this is an unreasonable requirement of the auto salvager and/or scrap metal processor with regard to the automobile. The title transfer and release from the State authority would supplement this. Many of the sections in this chapter could be general requirements and expected for all the industries, but others should be amended for specific situations as applicable.

Chapter 30 - Motor Vehicles and Traffic; Article XIV - Penalties, Procedure upon Arrest and Impounding; Sections 30-867 through 30-885; and Chapter 39 - Police Department; Sections 39-6, 39-9 and 39-10. These chapters were reviewed with regard to motor vehicle abandonment and police power to arrest and/or cite violations. It is suggested that the 40 days required for impoundment, and other time-consuming factors outlined in Sections 30-880 (Release of vehicle to owner after notice by State), 30-881 (Notice of sale of unclaimed vehicles), and 30-882 (Time, place and manner of sale), should be reviewed to determine the possibility of shortening the total required impoundment time. This would provide a faster turnover of stored vehicles and in particular the obviously abandoned type.

Chapter 46 - Rat and Pest Control; Article I - Ratproofing; Sections 46-1 through 46-17. Although no specific evidence of rodent or insect breeding was observed in this survey, hulks and weeds provide cover and water for rodents. The standing water in hulks and wet areas of salvage and scrap yards provide breeding places for insects. This chapter should include provision for control of conditions which produce desirable breeding environment for rodents and insects.

Chapter 51 - Smoke Abatement; Article I - In General; Sections 51-1 through 51-11; Article II - Construction, etc. of Combustion Units for Production of Heat or Power; Sections 51-12 through 51-23. This chapter was reviewed in conjunction with the open burning of automobiles under present conditions, and the recommendation that open burning be prohibited. Smoke caused by open burning should be included in this chapter and applicable sections. This chapter should include requirements for incineration facilities for automobile and/or general refuse.

3. Special Tree Waste

a. General. Normally, tree wastes are a small part of the total solid waste of a community. However, because of the Dutch Elm Disease in the Study Area, and the quantities of trees infected and being removed, special attention was given to this tree waste problem.

It is estimated that, since the discovery of the Dutch Elm Disease in the Study Area in 1959, 52% of the 260,000 original elm trees have been removed or are presently diseased and must be removed. The rate of tree loss per year has increased from about 0.5% in 1959, to approximately 15% for 1967. If the rate of loss continues to increase, all of the American Elm trees in the Des Moines area will be diseased by 1970.

By the end of 1967 approximately 104,000 diseased trees had been removed, most of which have been disposed of by landfilling methods at public sites. No volume or weight records have been maintained; therefore future volumes and weights are based on known properties of elm wood, existing estimates, and information developed in cooperation with city, state and Federal foresters.

For purposes of this report the American Elm trees have been divided into problem trees and other trees. Problem trees are those trees in populated areas and along roadways which are a potential hazard to life and property when they are dead.

The problem trees will be removed and are considered as solid waste which must be provided for. The other trees are those in remote or rural areas which probably will not be removed or will not be brought to solid waste disposal facilities. These other trees are not included in estimates of existing trees or trees to be removed and disposed of.

The greatest quantity of problem trees are located in the City of Des Moines and the immediate area. The amount of this special tree waste contributed by Study Area communities outside the city limits of Des Moines is estimated to be 35% of the amount of American Elm tree material that was in the City of Des Moines in 1959. Elm tree quantity calculations for the Study Area are shown in Table 2-3.

b. Disposal by Commercial or Industrial Use. Investigation indicates that elm wood has few commercial or industrial uses and then only if the user is close to the source of material to reduce shipping costs. Some elm wood is used for making pallets, dunnage, furniture and veneer,

Table 2-3

Elm Tree Quantity Calculations

1. Number of trees removed in City of Des Moines, 1959 through 1966:

   Private trees, 67,519; Public trees, 17,622; Total trees, 85,141.

2. Trees burned on site:

   Private trees, 10%; Public trees, 5%; Total trees, 9%.

3. Number of trees removed in Study Area, 1967: Total: 28,000.

4. Weight of trees removed in Study Area, 1967:

   28,000 trees @ 7,400 pounds each = 103,600 tons.

5. Number of trees burned on site in Study Area, 1967:

   9% x 29,000 trees = 2,500 trees.

6. Weight of trees burned in Study Area, 1967:

   2,500 trees @ 7,400 pounds each =9,200 tons.

7. Number of trees hauled to disposal sites, 1967:

   28,000 trees less 2,500 trees = 25,500 trees.

8. Weight of trees hauled to disposal sites, 1967:

   25,500 trees @ 7,400 pounds each = 94,300 Tons:

9. Volume of trees hauled to disposal sites, 1967:

   94,300 tons @ 1,145 pounds per C. Y. = 165,000 C. Y.

10. Volume of trees burned in Study Area, 1967:

    9,200 tons @ 1,145 pounds per C. Y. = 16,200 C. Y.

although the demand is very small. The physical properties of elm wood preclude its use as structural material. It tends to split and twist when drying. The largest consumers of elm wood are the pulp mills making fiberboard, corrugated boxing and particle board and similar material. The closest mills were located along the Mississippi River at Dubuque and Fort Madison. These mills use elm wood chips and other wood chips which are locally available and apparently there is no foreseeable shortage of supply. These industries indicated some interest in using the Des Moines area wood, but they would not accept it in log form. Processing the elm wood into chip form would require a local saw mill and chipping operation. The economics of this are questionable as shown in Appendix Exhibit 2-2, and discussed in the following paragraph.

It is estimated that 574,000 tons of useful chips could be produced and shipped for $4,723,000. At $8.00 per ton the receipts would be $4,592,000 for a net loss of $131,000. Comparing this total to the disposal costs of approximately $630,000, there appears to be a potential saving of approximately $500,000. This savings is approximately 10% of the total operating cost and could disappear if there were any unusual operating problems. Operating problems could be expected in chipping city trees due to the presence of tramp iron. Many mills refuse to accept city trees for chipping for this reason. Marketing elm wood for pulp purposes is not recommended.

Elm wood as a fuel for power plants was considered. It would again have to be chipped. After chipping the elm fuel would cost more per useful Btu than coal. This outlet was not considered further.

c. Disposal by Incineration or Open Burning. In another section of this report it is estimated that incineration of mixed solid waste costs approximately six times as much as disposal by sanitary landfill methods under conditions in the Study Area. In the preceding paragraph it was stated that the chipped elm wood cost more per useful Btu than coal. It is apparent that incinerators which would burn the elm wood are not feasible even when considering waste heat recovery. No further consideration was given to incineration of elm tree wastes.

It is possible to burn the elm trees in open fires. Although logs are difficult to burn,a proper arrangement could be made which would reduce most of the wood to ash. It would be possible to control such a burning operation from becoming a fire hazard although a considerable amount of land preparation and labor would be required. This method is not recommended because of the air pollution problem that would be created.

d. Disposal by Landfill. Diseased elm tree waste can be disposed of in landfill sites, separately or with other solid waste of the community. When filled separately, many sites would be available that might not be available for mixed operations. This is the only advantage. When filled alone considerably more earth is required. Logs are particularly difficult when handled alone. They pile up one upon another and make a very difficult surface upon which to work landfill equipment. The limbs are not adequate to solve this problem. Large quantities of earth are required to fill around logs to make a stable mass.

When filled with other solid waste from the community, the other material packs around the logs making a satisfactory working surface. Only cover dirt is required. With the other material adding to the total volume, the unit operating cost of the operation is reduced. It is less expensive to bury the elm tree waste with other solid waste than to bury it in a site separately.

The cost of operating a sanitary landfill in the Study Area has been estimated to be $1.10 per ton. This is the most economically acceptable way to dispose of the diseased elm tree wastes.

The present and future quantities of special tree waste are discussed in Sections H and I. Complete elm tree statistics and calculations are included in Appendix Exhibit 2-2.

4. Packing House Waste. The several packing houses in Des Moines were surveyed to determine the extent of their kill and the disposal of paunch manure and pen sweepings. The paunch manure and pen sweepings represent a considerable quantity of waste. None of this waste was measured at the landfill sites during the surveys because this material is currently being flushed down public sewers, or piled on the premises of the packing plants, or hauled to farm land.

It is doubtful that the City will allow the continued flushing of paunch manure down public sewers in the future. Paunch manure and pen sweepings cannot be treated in conventional sewage treatment facilities and if allowed to enter the plant in quantity, will cause clogging of pumps and pipe lines, and fill digesters with this material which digests very slowly.

It is also believed that packing plants will not be permitted to continuously pile this material on their premises and that farm land disposal will be uneconomical. Experience in other cities has shown that in recent years the packing industries have been required to dispose of this material to eliminate the odors caused by the decomposition of the organics and the problem with rat and insect control.

Paunch manure can be treated or disposed of using a variety of methods. It can be incinerated, dried for feed, or placed in sanitary landfills. Incineration is considerably more expensive than sanitary landfilling and is not considered further in this study. Feeding of paunch manure has been tried, and abandoned, over a period of many years. There are a few new processes which are preparing paunch manure for feed on a limited scale, but these processes have not been sufficiently proven.

The industry has found that the best way to dispose of paunch manure in an area like the Study Area, is by sanitary landfill. The industry may wish to dewater the material to reduce the weight of the material and the problems of hauling. Basically they will probably landfill it in the future.

Based upon calculations shown in Appendix Exhibit 2-3, the annual quantities of paunch manure and pen sweepings are estimated to be 11,300 tons or 11,200 cubic yards (compacted). Since these quantities are estimated for the current year, no seasonal adjustment is necessary.

These quantities were used as part of the total present quantities of commercial and industrial wastes summarized in Section H.

5. Sewage Solids

a. General. All of the municipal sewage solids in the Study Area are treated at sewage treatment plants. The 1967 plant population of the main Des Moines sewage treatment plant is 240,000 people. This is approximately 81% of the Study Area population. The remainder of the sewage is treated at several small treatment plants or in the case or rural areas, in individual septic tanks or similar facilities.

There is no practical way to accurately measure the quantity of solids at the Des Moines plant at this time, due to the intermittent and interrupted operation caused by current alterations and enlargement. However, there are recent figures available from the basis of design of the current improvements. These figures were used in developing the quantity estimate and included in Appendix Exhibit 2-4.

b. Disposal of Sewage Solids. The sewage solids of the Study Area are primarily those of the Des Moines sewage treatment plant. The characteristics used in this study are based on this plant's particular process which produces digested, dewatered vacuum filter cake, raw screenings, and washed grit. Other plants produce quantities somewhat different in physical characteristics, however they are assumed to be the same as Des Moines for this analysis. Small quantities of dewatered sludge from the smaller plants dewatering beds, when mixed with Des Moines filter cake, would be difficult to distinguish when placed in a large sanitary landfill with the other solid waste of the community. It would also be indistinguishable if burned in a sewage solids incinerator, or mixed with other solid waste in a general mixed refuse incinerator.

Three methods of disposal are considered in this study: Sanitary Landfill, Incineration With Mixed Refuse, and Incineration in a Sewage Solids Incinerator. These methods are explained, and the costs estimated in the following paragraphs.

c. Disposal by Sanitary Landfill Method. Sewage solids in the form of dewatered cake, which include sludge and settled grease; plus grit and screenings, may be disposed of by sanitary landfill methods. This method has a reputation which ranges from excellent to very bad. It is economical, but if managed poorly the results can be unsatisfactory. Properly managed, the economy can be enjoyed without the bad side effects.

Raw sludge, with or without grease, dumped in the open without proper covering, will cause odors which can be detected for miles. The same sludge properly buried either in a separate sanitary landfill or with other solid waste in a sanitary landfill will cause no odor.

Digested sludge has similar characteristics but presents less of a problem. Most of the solids in the Study Area are digested; therefore, we have confined this analysis to disposing of the digested sewage solids.

Sewage solids cake from a vacuum dewatering filter will compact with other refuse without difficulty; although a somewhat higher settlement can be expected than compacted refuse alone. The settlement would not become a problem due to the relatively small amount of sewage solids compared to the volume of refuse. If sewage solids were filled in a site separate from other refuse, the depth of fill should be less per layer, and more earth required for mixing, but many layers could be formed over a period of time.

Sewage solids can be landfilled if reasonable care is exercised and proper facilities are provided. This method of disposal has been used with success in many communities.

The cost of sanitary landfilling sewage solids is made up of two basic parts, i. e. hauling and filling. The cost estimate for disposal by sanitary landfill methods is estimated at $0.49 per C.Y. This estimate is based on filling with other refuse from the City. If a separate sanitary landfill site can be located significantly closer to the sewage treatment plant, the cost of hauling can be reduced. To bury a small quantity of material would cost more per cubic yard than the unit cost associated with the large refuse landfill operation; therefore, the haul savings would have to be great enough to offset the increased filling cost. It is likely that such a savings can be made. In the cost estimate shown in Table 2-4, the fill cost is $0.49 per C.Y. and the haul cost is $1.11 per C. Y. If the unit fill cost were increased by 100%, the savings could still be made if the haul was reduced by 37% or more. To accomplish such a savings, the haul would have to be reduced from 1 hour per round trip to 38 minutes or less.

In the case of Des Moines' sewage treatment plant, the land adjacent to the plant now used for sludge lagoons could be developed for emergency sanitary landfilling of solids to be used during bad winter weather. Immediate plans will require the disposal of sewage solids before the future landfill site is established. If landfill methods are adopted, the present City landfill site could be used, or a separate site established. For purposes of evaluation of long term methods, the cost of separate landfill operation is based on the same cost as landfilling with general refuse.

Table 2-4

Cost of Disposal of Sewage Solids by Sanitary Landfill Methods

1. Haul Cost

   a. Assume average day loads, 1967 to 1987

      1. Filter cake, screenings and grit, per average work day, average year, is 180 C. Y. per day.
      2. Using a 10 C. Y. truck, there are 18 loads per day.
      3. A truck of this type with fuel and driver and all other expenses, costs approximately $9.50 per hour.
      4. The location of the sanitary landfill site is assumed to be in the vicinity of the intersection of I-35 and I-80, northeast of Des Moines. It is estimated that a round trip would take 60 minutes, plus 5 minutes turnaround time at each end. Total time per load = 70 minutes.
      5. 18 loads @ 1.17 hours each = 21.1 hours per day.
      6. Daily cost of 21.1 hours @ $9.50 per hour = $200.00 per day.
      7. Cost per C. Y. = $200.00 ÷ 180 C. Y. = $1.11 per C. Y.

2. Land Fill Cost

   Assume same cost as for General Refuse, if it is buried with the other city refuse. (49¢ per C. Y.).

3. Total Cost

Hauling	$1.11
Fill	.49
	$1.60 per C. Y. @ 1760 lbs/C. Y. = $1.82 per ton wet.

d. Disposal by Incineration. Sewage solids, with or without grease, can usually be incinerated in any of several sewage solids incinerators, or mixed with refuse and burned in a mixed refuse incinerator. The City of Des Moines is planning to install grease and scum incineration equipment at their main plant. Therefore these calculations are based on quantities and characteristics of digested solids without floated grease and skimmings.

(1) Incineration in Sewage Solids Incinerator. There should be sufficient heat to burn the digested sewage sludge without the addition of supplemental fuel; however, it may be necessary to mix some grease with the sludge to increase its heat content for deodorization. These calculations and estimates are based on the assumption that there will be sufficient heat content to accomplish burning and deodorization without the need for additional grease or supplemental fuel. This incineration can be accomplished in a variety of incinerators.

(2) Incineration by Mixing with Refuse. If the sewage solids are incinerated with other solid waste in a refuse incinerator, the sludge probably would have to be pre-dried. There are several types of driers available to accomplish this purpose.

(3) Costs of Incineration in a Sewage Solids Incinerator. The cost of disposal is based on quantities developed in Appendix Exhibit 2-4 The quantities, explanations and costs are shown in Appendix Exhibit 2-5. The costs are estimated at $9.74 per ton for dry weight solids and $2.91 per ton on a wet basis.

(4) Cost of Incineration With Refuse. To incinerate sewage solids with general refuse in a municipal incinerator would cost approximately the same as general refuse. A general refuse incinerator is designed to handle material with a moisture content considerably less than the filter cake and therefore a higher solids content. The cost of pre-drying should be offset by reduced unit handling expense. The cost of incinerating general refuse, as developed in another part of this report, is estimated to be $6.50 per ton on an "as received" basis, with up to 40% moisture. This is equal to $10.83 per ton of dry weight. The sewage solids will have a solids content of approximately 30%. The cost of incinerating the mixture of sludge cake, grit and screenings is estimated to be $10.83 per ton on a dry weight basis and $3.25 per ton on a wet basis.

e. Recommended Method of Disposal. The disposal of sewage solids can be accomplished by sanitary landfill or incineration. A comparison of the unit cost on a wet and dry basis, and total costs are given in Table 2-5.

Since all three methods are acceptable, the recommendation is based on economy.

It is recommended that sewage solids be disposed of by sanitary landfill methods.

Table 2-5

Summary of Disposal Costs for Sewage Solids

Method	18,300 Tons Dry Basis	61,200 Tons Wet Basis	Cost Per Year
Incineration mixed with refuse	@ $10.83/ton	@ $3.25/ton	$198,000
Incineration not mixed with refuse	@ $ 9.47/ton	@ $2.91/ton	$178,000
Sanitary landfill	@ $ 6.07/ton	@ $1.82/ton	$111,000

Note: Tonnages used both dry and wet, are based on average year.

6. Rubber Industry Solid Waste. There are two major manufacturers of rubber products in the Study Area. The total volume of waste from this industry is small when compared to the waste from the community as a whole.

Part of the waste is solid, such as scrap tires and trimmings, and miscellaneous rubbish. This waste is currently being disposed of at public disposal sites and presents no problems. Part of the waste is semi-solid and presents several problems. The problem wastes consist of volatile fluids such as naptha, some grease and oils, white side wall dust and black rubber dust.

The naptha solvents are presently burned at the Polk county landfill site in an open pit. The other materials are landfilled.

The naptha solvents should not be burned in the open nor allowed to evaporate due to air pollution problems and fire hazards. The oils and greases could be landfilled with other wastes although these require special attention. The white side wall dust is a special fire hazard due to spontaneous combustion. It cannot be safely included in landfilling operation with other combustible material. The black rubber dust is a finely ground material which sticks to landfill machines and is disagreeable to the operators.

These special problem wastes should be excluded from the landfill sites under normal circumstances. There are wastes from other industries which are hazardous. These industries are required to safely dispose of their own waste or process them to a harmless state before depositing them in a public disposal facility. The rubber industry should be required to do the same.

Frequently an industry dumps waste products as the least expensive method of disposal. If dumping or similar inexpensive disposal is not available, industries have found many ways to dispose of the waste. In some cases the waste or part of the waste is reclaimed. The cost may be greater than dumping but the cost of treatment of the remaining waste is reduced. In other cases industries have reprocessed combustible waste material and used them as fuels.

There are several ways this industry can dispose of their hazardous waste and they should be required to do so. Their other waste should be accepted.

7. Other Special Waste Industries. There are several industries in the Study Area that create solid or non-solid wastes which could be hazardous if disposed of in sanitary landfill sites. Included in part in this category are pharmaceutical plants, drug wholesalers, hospitals, herbicide and insecticide manufacturers, paint manufacturers and metal plating industries.

These industries recognize the hazardous nature of their waste material and either pretreat it to render it harmless or dispose of it in their own facilities. The managers of public landfill sites should however be alert to hazardous materials.

E. Landfill Surveys.

1. General. A seven day 24 hour per day surveillance was established at each of six major landfill sites in the Study Area. The sites were continuously manned by from one to four technicians, except when the site was officially closed to preclude deliveries of waste.

The sites and the dates of the surveys are given in Table 2-6.

Table 2-6

Dates and Locations of Landfill Surveys

	Days						
Locations & Dates	1st	2nd	3rd	4th	5th	6th	7th
West Des Moines 6/12 to 6/18/67	M	T	W	T	F	S	S
Polk County 6/13 to 6/17/67	T	W	T	F	S	S	M
Ankeny 6/23 to 6/29/67	F	S	S	M	T	W	T
Euclid Ave (Private) 6/23 to 6/29/67	F	S	S	M	T	W	T
Des Moines #1 7/17 to 7/23/67	M	T	W	T	F	S	S
Des Moines #2 7/27 to 8/2/67	T	F	S	S	M	T	W

It was apparent that most of the solid waste was being deposited at the two sites operated by the City of Des Moines; however, the site operated by the City of West Des Moines and the site operated privately on Euclid Avenue were receiving enough material to be significant. Two other sites, Polk County and Ankeny were included to be certain not to pass up an opportunity to gather adequate data. The disposal at the remainder of the sites was negligible and was included in the estimates of on site disposal.

The purpose of the site surveys was to determine the quantity and characteristics of solid waste being delivered to places of disposal, plus other valuable data which could be acquired at the same time. Most of the solid waste being generated in the community must be removed from the source at regular intervals. Thus if a continuous surveillance is maintained during the course of an entire week the information acquired will be representative of the waste being generated. The data acquired must be adjusted and supplemented with other data. However, this data is the major source of information concerning the solid waste of the community.

Solid waste as received at a place of disposal is an extremely heterogeneous material. The usual way to determine the characteristics of the material is to analyze representative samples as received. A different approach was taken during the landfill surveys. Each load as it arrived at the disposal site was viewed and the type of material in the load recorded. Where there was a mixture of materials, an estimate of the percentage of each material was made. Certain anticipated mixtures were considered as material classifications in themselves. An explanation of the development of the unit weights for the various material classifications is included in Appendix, Exhibit 2-6.

Such an approach would have been impractical without the use of computers which are able to process the large quantity of information (more than 9000 loads were received and recorded). By knowing the characteristics of the materials and the total quantity of each, it is possible to make reasonably accurate estimates of the solid waste of the entire Study Area.

While the quantity and types of materials were being recorded, other information was also obtained. The nature of this information and how it was processed and used is described in the following paragraphs concerning major computer programs, and in various other sections of the report. However, it is appropriate to briefly mention the information here by describing the survey form. This form, Figure 2-4, "Landfill Survey Questionnaire" is reproduced in this section. The instructions giving the details for its use are included in the Appendix as Exhibit 2-7. The form included provisions for recording the following:

1. Book Number.
2. Date of Survey.
3. Time of Day.
4. County License of Vehicle Registration.

LAND FILL SURVEY QUESTIONNAIRE - METROPOLITAN DES MOINES SOLID WASTE STUDY

BOOK NO.		DAY			TIME					CO. LIC.			TYPE VEHICLE		TYPE OF HAULER																VOLUME CY.					
															NO.			%			NO.		%			NO.		%								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
		☒			☒					☒			☒	☒	☒			☒			☒		☒			☒		☒			☒					

ADDRESS OF SOURCE

____

____

____

CONDITION OF MATERIAL
1. VERY DENSE
2. VERY LOOSE

1. PACKER
2. DUMP
3. VAN
4. LT. TRAILER
5. HVY. TRAILER
6. FLAT BED
7. PICKUP
8. AUTO
9. OTHER________
____

1. GENERAL CONTRACTOR
2. WRECKING CONTRACTOR
3. PAVING CONTRACTOR
4. COMMERCIAL HAULER - DOM.________%
5. COMMERCIAL HAULER - COM'L.________%
6. COMMERCIAL HAULER - IND.________%
7. PRIVATE COMMERCIAL
8. PRIVATE INDUSTRY
9. CITY REFUSE
10. OTHER CITY VEHICLE
11. PRIVATE CITIZEN

SIZE OF LOAD

CY.____________

% FULL____________

L____________

W____________

H____________

COORDINATE								GOV. SUB			COND. MAT'L		TYPE OF MATERIAL																								
SOUTH				WEST									MAT'L			%			MAT'L			%			MAT'L			%			MAT'L			%			
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	
☒				☒				☒			☒		☒			☒			☒			☒			☒			☒			☒			☒			

1. DEMOLITION-MIXED, NON-COMBUST.
2. DEMOLITION-MIXED, COMBUST.
3. DIRT, SAND OR GRAVEL
4. ROCK
5. BROKEN PAVEMENT OR SIDE WALK
6. CONSTRUCTION MIXED
7. STREET SWEEPINGS
8.
10. LOGS & STUMPS 10" DIA. & GREATER
11. LOGS & STUMPS LESS THAN 10" DIA.
12. LIMBS & LEAVES CHIPPED
13. LIMBS & LEAVES NOT CHIPPED
14. BRUSH
15. GRASS & GARDEN
16.
20. PAUNCH MANURE
21. PEN SWEEPINGS
22. OTHER MEAT PACKING WASTES
23. POULTRY PROCESSING WASTES
24.

25. TIRES & RUBBER PRODUCTS - NEW
26. TIRES & RUBBER PRODUCTS - USED
27. RUBBER MFG. WASTES
28. OILS, TARS & ASPHALTS (LIQUIDS)
30. BEANS OR GRAIN WASTES
31. POTATO PROCESSING WASTES
32. OTHER FOOD PROCESSING WASTE
33. FRUITS & VEGTABLES
35. ASHES AND CINDERS
36. FLY ASH
37. CEMENT INDUSTRY WASTE
38. OTHER FINE PARTICLES
39.
40. GARBAGE & KITCHEN WASTE, DOMESTIC
41. GARBAGE & KITCHEN WASTE, COM'L.
42. MIXED TRASH & REFUSE (INCL. GARB.)
43. MIXED TRASH & REFUSE (NO GARBAGE)
44. INCINERATOR RESIDUE DOMESTIC
45. INCINERATOR RESIDUE COM'L & INC.
46.

50. PAPER & CARDBOARD
51. CANS
52. FURNITURE COMBUST.
53. FURNITURE
54. MAJOR APPLIANCES
55. HEAVY METAL SCRAP
56. LIGHT METAL SCRAP
57. WOOD CRATES
58. GLASS AND BOTTLES
59. BATTERY CASE & AUTOMOTIVE
60. AUTOMOBILE BODIES
61. WIRE
62. CHEMICAL WASTE, DRY
63. CHEM. WASTE, LIQ. OR WET
64.
70. SEWAGE SLUDGE SOLIDS
71. SEWAGE GRIT
72. SEWAGE SCREENINGS
73. SEWAGE GREASE SKIMMINGS
74.

FIGURE 2-4

5. Type of Vehicle
6. Type of Hauler.
7. Volume of Material.
8. Condition of Material.
9. Location of Source of Load.
10. Coordinate of Source of Load.
11. Governmental Subdivision of Source of Load.
12. Type of Material.
13. Percent of Each Type of Material.

The landfill surveys were scheduled to avoid unusual conditions. Weeks containing holidays were avoided. Where a holiday fell on or near a weekend the surveys were delayed beyond the weekend to avoid recording accumulations due to the holiday. Similarly, weather conditions were considered. Where rain and wet weather became a possible factor, one survey in progress was abandoned and restarted after the weather and site conditions had improved. Each survey covered a seven consecutive day period free of disruptive conditions.

2. Computer Programs.

a. General. In all of the programs, certain terminology is used which must be understood. The reader is cautioned to be certain the right data is selected and the right conditions and units are used. The terminology is not difficult or profound; it is tedious. Reference will be made to computer programs by program designations A through I. These programs are further designated by sortings. For example, Program A, "Quantities of Materials by Disposal Process and by Hours of the Day" was produced in 49 varieties by sorting the data into 49 different groups or combinations. There were 8 sorts for each of the six sites representing the seven individual days and the summation of the entire week, and one additional sort which produced the sum of all days and all sites. Where the sorting was by days, the totals are per day, and when sorted by the entire week, the totals are per week. The week or day may be seasonally adjusted to convert the raw data to a typical day or typical week, but in each case it is labeled to reflect the true conditions. There are certain cases where this procedureis changed; however, the data is properly marked to reflect the true conditions.

Before any programs were run, all of the data was tested in specific test programs to find potential errors. These test programs are described in the Appendix Exhibit 2-8. In total there were 49 sorts for each of the Programs A through D; nine sorts each for Programs E, F and G; plus one each for Programs H and I, for a total of 225 sets of data. All of the data is not reproduced in this report because of the volume of material. Certain portions have been reproduced where appropriate. The entire data is available for interested persons.

Not all of the data was used in the analysis of the problems peculiar to this Study Area. In some cases the data was produced for the benefit of researchers who may have use for the data not previously available. The various combinations of data in some cases were the result of simply leaving a **computer subprogram** in a main program, and acquiring basic data as a byproduct while obtaining certain required information. We have tried to describe the data, how and under what conditions it was gathered, and how it was adjusted, to make this information as useful as possible to others with similar problems. We have attempted to produce data and report exactly the source and conditions both for our use and for the use of others as it may apply.

The data was processed on an IBM 360/65 computer with a 262K memory. The data was established on cards and then converted to magnetic tape for processing.

The terms which are common to several programs are explained as follows:

(1) Cubic Yards as Received. These are the cubic yards of material appearing in Columns 33-36 of the survey form. They are not adjusted for seasonal or compaction factors. They are adjusted for Condition of Material as indicated in Column 49 of the survey form. They are also adjusted for packer trucks.

(2) Packer Truck Adjustment. Where the material was delivered in a packer truck, it was considered pre-compacted to the extent that if it had been delivered loose, it would have occupied three times the volume actually measured in the truck. Since each material has been assigned a compaction factor, a seasonal factor, and a unit weight based on a loose "as received" condition, materials delivered in a packer truck use the same factors, but the volume is automatically multiplied by three. Quantities shown as "As Received," include the material brought in packer trucks, but is reported as the larger volume which would have been received if a non-packer truck has been used.

(3) Pounds as Received. The same as "Cubic Yards as Received" except the volume of each material on each load was multiplied by the appropriate unit weight for that particular material to convert from cubic yards to pounds. The unit weights used are shown in Table 2-7.

(4) Vehicles, or Vehicles this Hour are simply a count of the vehicles for the appropriate unit of time.

Table 2-7
Seasonal and Compaction Factors and Unit Weights

	Materials	Seasonal Factor	Compaction Factor	Unit Wt. #/CF	Unit Wt. #/CY
1.	Demolition-Mixed, Non-Combust.	.6	.8	90	2400
2.	Demolition-Mixed, Combust.	.6	.7	22	600
3.	Dirt, Sand or Gravel	.6	.8	90	2430
4.	Rock	.6	.6	90	2430
5.	Broken Pavement or Sidewalk	.6	.7	95	2560
6.	Construction Mixed	.6	.7	60	1620
7.	Street Sweepings	.7	.9	85	2300
10.	Logs & Stumps 10" dia. and greater	.9	.5	25	675
11.	Logs & Stumps less than 10" dia.	.9	.5	25	675
12.	Limbs and Leaves chipped	.6	.4	12	320
13.	Limbs and leaves not chipped	.6	.3	10	270
14.	Brush	.6	.1	2	54
15.	Grass & garden	.6	.2	5	135
20.	Paunch manure	1.0	.8	64	1730
21.	Pen sweepings	1.5	.6	40	1090
22.	Other meat packing wastes	1.0	.8	64	1730
23.	Poultry Processing wastes	1.0	.8	64	1730
25.	Tires & rubber products - new	1.0	.2	15	400
26.	Tires & rubber products - used	1.0	.2	15	400
27.	Rubber mfg. wastes	1.0	.3	55	1500
28.	Oil, tars & asphalts (liquid)	.8	.1	60	1620
30.	Bean or grain wastes	1.0	.8	48	1300
31.	Potato Processing Wastes	1.0	.8	42	1130
32.	Other food processing waste	1.0	.6	20	540
33.	Fruits and vegetables	0.8	.5	35	950
35.	Ashes and cinders	2.0	.9	45	1220
36.	Fly ash	1.0	1.0	80	2160
37.	Cement industry waste	1.0	1.0	90	2400
38.	Other fine particles	1.0	.9	60	1620
40.	Garbage & kitchen waste, dom.	.9	.3	6.2	167
41.	Garbage & kitchen waste, com.	.9	.3	6.2	167
42.	Mixed trash & refuse (inc. garb.)	.9	.2	5.2	140
43.	Mixed trash & refuse (no garb.)	.9	.2	5.2	140
44.	Incinerator Residue Domestic	1.0	.7	30	810
45.	Incinerator residue com. & ind.	1.0	.7	30	810
50.	Paper & cardboard	1.0	.2	4.5	120
51.	Cans	1.0	.2	6	160
52.	Furniture Combust.	1.0	.2	3	80
53.	Furniture non-combust.	1.0	.2	3	80
54.	Major appliances	1.0	.2	11	300
55.	Heavy metal scrap	1.0	.9	150	4050
56.	Light metal scrap	1.0	.3	50	1350
57.	Wood crates	1.0	.5	11	300
58.	Glass and bottles	1.0	.9	26	700
59.	Battery cases and automotive	1.0	.9	45	1200
60.	Automobile bodies	1.0	.3	8	216
61.	Wire	1.0	.2	20	540
62.	Chemical waste, dry	1.0	.9	40	1080
63.	Chemical waste, liquid or wet	1.0	.1	60	1620
70.	Sewage sludge solids	1.0	.9	65	1750
71.	Sewage grit	1.0	.9	80	2200
72.	Sewage screenings	1.0	.9	60	1600
73.	Sewage grease skimmings	1.0	.9	60	1600

(5) Seasonal Factor Adjustment. A factor was assigned to each material which would adjust the amount of material received during the day or week to the average daily or 7-day rate which would be experienced over the entire year. The factors are shown in Table 2-7.

(6) Compaction Factor Adjustment. A factor was assigned to each material which would adjust the material received during the day or week to reduce its volume "as received" to the volume which it would occupy when mixed with other materials and was compacted into a landfill. Cover dirt is not included. See Table 2-7.

(7) Other terms are explained in the program description where they are used.

b. Computer Program A - Quantity of Refuse by Disposal Process and by Hours of the Day. In this program the materials were sorted by hours of the day and by potential disposal process. The hours started at midnight and ran through the 24-hour day. Five potential disposal processes were considered. Each load was examined by the computer and compared to a set of instructions which determined if that load could be accepted by the process. If it could, the load was recorded for the process. If it could not, the load was recorded in the space next to that process marked "To Land Fill" or "Not for --------" as appropriate. For example, a load of broken pavement would be accepted at a sanitary landfill and so recorded. When considered for incineration it was rejected and sent "To Landfill." When considered for composting it would be rejected and sent "To Landfill." As soon as one potential process was completed, the next process was considered. The load is included in all five processes.

The Sanitary Landfill Process would accept all materials and is the same "As Received CY" and "As Received Pounds" except the cubic yards have been adjusted for compaction and seasonal variation, and the pounds have been adjusted for seasonal variation only.

The Incineration Process - All loads and each material content of a load were checked to determine if the load could be accepted at an incinerator or should be diverted to a sanitary landfill. Loads consisting of materials 2, 6, 12 through 26, 30 through 33, 40 through 43, 50, 51, 52, 57 and 70 through 74 would be accepted. Other loads containing less than 25% of the materials not listed above would be accepted. All other loads would be diverted from the incinerator to a sanitary landfill. On this basis, two sets of data were determined, i. e. "To Incinerator" and "To Landfill." In each of these two main classifications, the material is shown in cubic yards and pounds. They are adjusted for seasonal factor and for compaction factor where appropriate.

The Composting Process - All loads and each material content of a load were checked to determine if the load could be accepted at a composting plant or should be diverted to a sanitary landfill.

Loads consisting of materials 12 through 23, 30 through 33, 40 through 43, 50, 70, 71 and 72 would be accepted. Other loads containing less than 10% of the materials not listed above would be accepted. All other loads would be diverted from a composting plant to a sanitary landfill. On this basis, two sets of data were determined, i. e. "To Composting" and "To Landfill." In each of these two main classifications the material is shown in cubic yards and pounds. They are adjusted for seasonal factor and for compaction factor, where appropriate.

The Dry Land Fill - All loads and each material content of a load were checked to determine if the load could be dumped in a dry landfill site. This site would be similar to a sanitary landfill but would be one which would not require the same degree of care in handling and covering to protect the community from rats, odors, gases, unsightly refuse and insects. It could be a gulley or low area in town where filling was desired. Material which could not be dumped in a dry landfill would be diverted to a sanitary landfill site for disposal. Loads consisting of materials 1 through 5 and 35 through 37 would be accepted. All other loads would be diverted to a sanitary landfill. On this basis, two sets of data were determined, i. e. "To Dry Landfill" and "Not to Dry Landfill." This latter set would be to Sanitary Landfill. In each of these two main classifications, the material is shown in cubic yards and pounds. They are adjusted for seasonal factor and for compaction factor, where appropriate.

The Wet Land Fill - All loads and each material content of a load were checked to determine if the load could be dumped in a wet landfill site. This site would be similar to a worked out quarry where there was standing water or any other site subject to ground water inundation where contamination of ground water through leaching could occur. Material which could not be dumped into such a wet landfill would be diverted to a sanitary landfill for disposal. Loads consisting of Materials 1, 3, 4 and 5 would be accepted. All other loads would be diverted to a sanitary landfill. On this basis, two sets of data were determined, i. e. "To Wet Landfill" and "Not to Wet Landfill." In each of these two main classifications, the material is shown in cubic yards and pounds. They are adjusted for seasonal factors and compaction factors where appropriate.

Program A was run for each day, for each site; for the totals for each site; and the totals for all days, all sites. The totals for each site and totals for all days, all sites are shown in Exhibits 2-9 through 2-15.

c. Computer Program B - Quantities of Refuse by Disposal Process and by Type of Vehicle. This program is the same as Program A except the type of vehicle has been substituted for the hours of the day. The vehicle types are those recorded in column 15 of the survey form.

Program B was run for the same days, sites and totals as Program A. Only the run containing all days, all sites is shown in Exhibit 2-16.

d. Computer Program C - Quantity of Refuse by Disposal Process and Type of Hauler. This program is the same as Program A except the type of hauler is substituted for the hours of the day. The types of haulers are those shown in columns 17 and 18, of the survey form and explained in Exhibit 2-7. The number of vehicles for each hauler type will not add up to the total shown. The total is correct and represents the actual number of vehicles during the day or week; however, where a hauler type 4, 5, or 6 was involved, the vehicle was counted each time the 4, 5 or 6 appeared. A single vehicle with part 4, part 5 and part 6 loads would be recorded in all three places.

Program C was run for the same days, sites and totals as Program A. Only the run containing all days for all sites is shown in Exhibit 2-17.

e. Computer Program D - "As Received" Quantities of Refuse by Type of Vehicle and by Hours of the Day. In this program the "As Received" quantities are sorted by type of vehicle and by hours of the day. The program is self-explanatory except to note that the quantities in both cubic yards and pounds are not adjusted for seasonal or compaction factors.

Program D was run for the same days, sites, and totals as Program A. Only the run containing all days for all sites is shown in Exhibit 2-18.

f. Computer Program E - Quantities of Refuse and Adjustment Factors by Material Classification. In this program all loads were examined and each material in a load was sorted by material classification. The quantity of material in each classification was adjusted for seasonal and compaction factors for each material, one at a time.

The several columns of data produced are explained as follows:

(1) Material Received: The cubic yards and pounds are as received but added are the percent of each material to the total.

(2) Compaction Factor: The factors used to adjust "as received" loose quantities to "compacted in place" quantities.

(3) Compacted C. Y.: These are the as received cubic yards multiplied by the compaction factor expressed as C. Y. and as % of total.

(4) Seasonal Adjustments: The factor used to adjust the quantities measured during the survey week to make these quantities representative of the entire year. COMPCY is the cubic yards as received and adjusted for compaction factor multiplied by the seasonal factor.

The % CY which follows COMP CY is the % of this material to the total after adjustment for compacting and seasonal factor. The POUNDS and % POUNDS are as received quantities adjusted for seasonal factor only. (Pounds cannot be compacted). CUBIC YARDS are the as received cubic yards adjusted for seasonal factor only. They are not compacted.

Program E was run for the totals for each site, and for the totals of all days for all sites. These programs are shown in Exhibit 2-19 through 2-25.

g. Computer Program F - Centroids of Refuse by Material Classification. This program is primarily for the purpose of determining the centroids of materials which will be explained below; however, a summation of volumes and weights was included for convenience. This summation is the volume and weight of material normally stated in cubic yards and pounds per week, or per day. In this case, the volumes and weights have been increased to represent an annual quantity. The volume is acre feet per year adjusted for seasonal and compaction factors. The weight is tons per year adjusted for seasonal factor only.

Centroids were computed for both south and west coordinates. They were computed by dividing, the sum of all of the products of coordinates times the load by the sum of the load, where the load was expressed in both seasonally adjusted cubic yards and seasonally adjusted pounds.

$$C = \frac{\sum \text{Coordinate X CY}}{\text{CY}} \quad \text{also} \quad C = \frac{\sum \text{Coordinate X Pounds}}{\text{Pounds}}$$

The coordinates are those recorded in columns 38 through 44 of the survey form. The cubic yards and pounds are "as received".

The centroids represent the single theoretical location of all of the material within a sort. This may be the centroid of a material, a site, or the entire study area, as appropriate.

In the typeout, the columns reproduced are marked CY SUM or LB SUM. These are the summation of CY X Coordinate or POUNDS X Coordinate as appropriate. The columns marked CY CORD and LB CORD are the coordinates of a point on a map. They represent the distance south or west of base lines expressed in feet x 1000.

Program F was run for the total of each site and the total of all sites for all days. These programs are shown in Exhibit 2-26 through 2-32.

h. Computer Program G - Centroids of Refuse by Material Classification Sorted by a Time Line into Two Sanitary Landfill Zones. This program is the same as Program F except the loads were sorted into two zones as described in Part IV, Section I-2. The information is the same and in the same units as in Program F but the quantities are for each of two sanitary landfill sites instead of for a site or for all sites.

With all loads combined in one deck, the coordinates for each load were compared to the coordinates of a line which was drawn through the Study Area. The line represented the locus of points, each of which was an equal driving time from the two future landfill site areas or zones.

The computer sorted each load into the zone in which it was located. The program was then run exactly as Program F. The results represent the loads in each of the two zones and indicated the centroids and quantity of material which could be expected to be received at each of the two sites.

The computer runs are shown in Exhibit 2-33 and 2-34.

i. Computer Program H - Quantities of Refuse by Political Subdivision. This program determined the cubic yards and pounds, and percent cubic yards and pounds on an as received basis for each political (governmental) subdivision found in columns 46 and 47 of the survey form. The code is explained in the Appendix Exhibit 2-35.

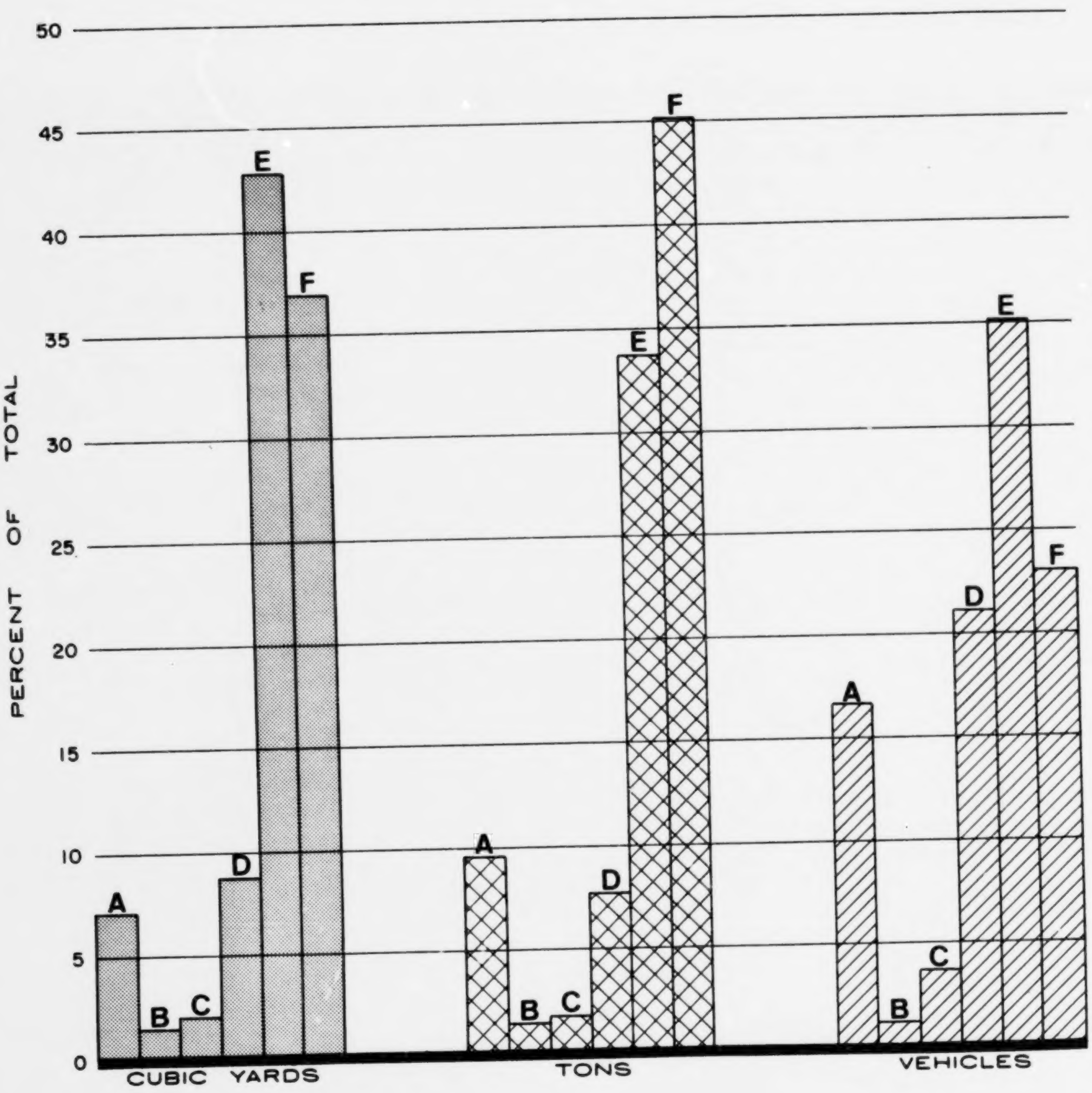
j. Computer Program I - Quantities of Refuse by County Vehicle Registrations. This program determined the cubic yards and pounds, and percent cubic yards and pounds on an as received basis for each county vehicle registration code found in columns 12 and 13 of the survey form. The codes are identified in Section G-1, Table 2-8.

F. Volume, Weight and Vehicle Analysis

1. General. Computer programs A through D are the principal source of information concerning volumes and weights of waste material. They indicate when and by whom the materials were delivered, other information concerning vehicle types and the relative amount of material disposed of at the several landfill sites surveyed. This information will be of value in making detailed plans for operation of the two new sanitary landfill sites recommended in Part Four of this report. Much of this information was used in developing the recommendations and preliminary planning shown in Part Four.

The following explanations show what are believed to be the items of greatest significance concerning the study area.

2. Comparing the Several Sites for Waste Quantities and Vehicular Traffic. Figure 2-5 shows the percentage by volume and weight of material, and vehicular traffic at each of the six major landfill sites surveyed. This information was taken from the summary of all days for each site, as received. This figure graphically illustrates that most of the material is being brought to the two Des Moines sites.



DISPOSAL SITES

A - *WEST DES MOINES -(Operates seven days, from 0900 to 2000 hours)*
B - *POLK COUNTY -(Operates five days, from 0900 to 1730 closed Sun. & Mon.)*
C - *ANKENY -(Operates six days, from 0900 to 1700 hours, closed Sun.)*
D - *EUCLID - (Private operator seven days, from 0800 to 1730 hours)*
E - *DES MOINES #1 -(Operates seven days, 24 hours)*
F - *DES MOINES #2 -(Operates six days, from 0800 to 2200 hours, closed Sun.)*

For quantities and weights see Exhibits 2-9 thru 2-14 for individual sites and 2-15 for the total. One hundred percent equals 47353 C.Y./Wk.; 11,400 Tons/Wk.; 9012 Veh./Wk.; as received.

COMPARING THE SEVERAL SITES
FOR
WASTE QUANTITIES & VEHICULAR TRAFFIC

FIGURE 2-5

The Des Moines Site No. 2 has a higher tonnage than Site No. 1. This is explained in the fact that this site receives the heavy building demolition material and the logs from the Dutch Elm removal program. Site No. 1 has large quantities of paper which accounts for the high volume and low weight.

The Euclid Avenue Site has a higher vehicle count than one would expect with the relatively low quantities. This is due to a large number of automobiles which use this site. Each automobile brings only a small load.

Reasons for any unusual pattern can be found by examining the detailed computer programs.

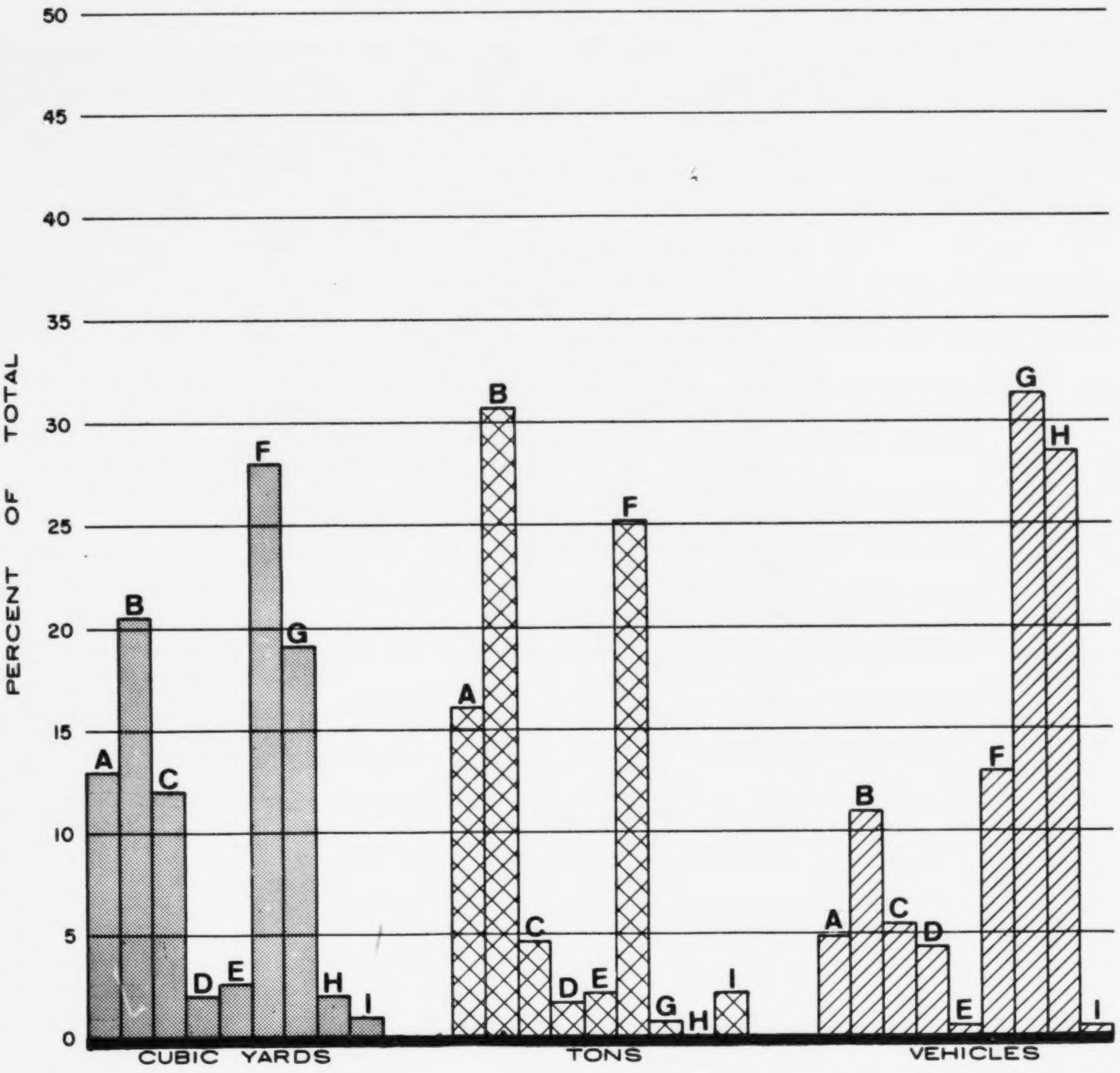
3. Comparing the Several Vehicle Types for Waste Quantities and Vehicular Traffic. Figure 2-6 shows the percentage by volume and weight of materials, and vehicular traffic for the nine different types of vehicles. It might be expected that most of the material going to a landfill site would be brought in packer trucks hauling waste from the residential dwellings in the community. This is incorrect. Such waste is a major category and a significant quantity as shown in the figure, but the other waste in the community far exceed the domestic waste. The largest volume is brought in flat bed trucks; principally Dutch Elm tree waste. They also carry the second highest percentage of the tonnage although they do not represent a large traffic count.

The highest tonnage is brought in dump trucks. Approximately 12% of all tonnage was comprised of dirt, sand and rock. These materials are normally transported in dump trucks. They also represented a low traffic count.

The largest traffic is in pick-up trucks and automobiles. These vehicles bring a negligable tonnage and only a medium volume. This volume is "as received" and usually very loose.

The automobile is a high traffic and low quantity category. In another section, it is recommended that the automobile be excluded from the main landfill areas. They add to the traffic but deposit only a small amount of material. The recommendation suggests that automobiles be given a free and highly accessible special place to deposit their material near the entrance to the landfill site.

4. Comparing the Several Hauler Types for Waste Quantities and Vehicular Traffic. Figure 2-7 shows the percentage by volume and weight of materials, and vehicular traffic for the eleven different types of haulers. In this figure the largest volume appears in the Private Commercial Type G. This includes the haulers with Dutch Elm tree disease wastes, which has a major influence on the category.



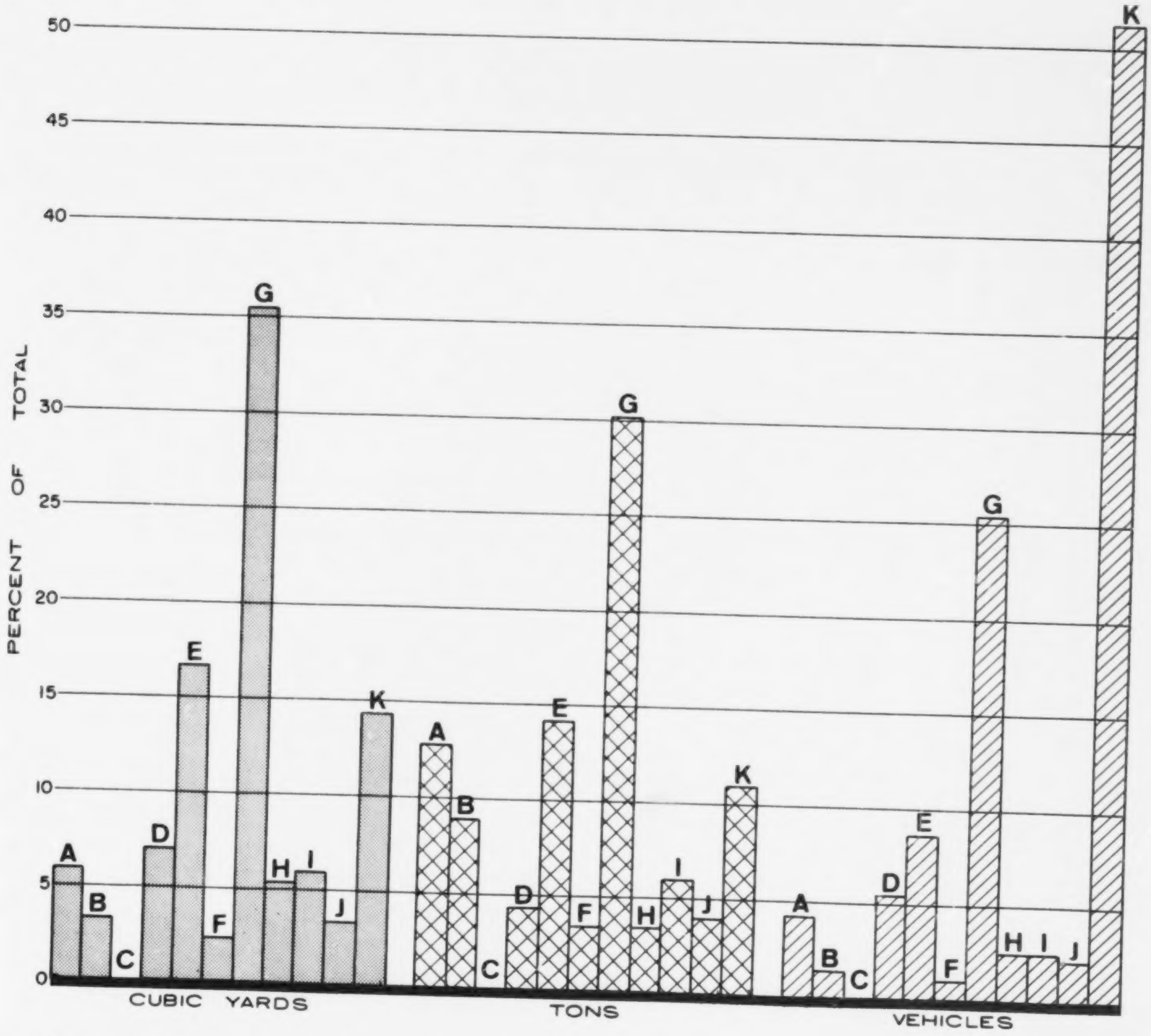
VEHICLE TYPES

A - *PACKER TRUCKS*
B - *DUMP TRUCKS*
C - *VAN TRUCKS*
D - *LIGHT TRAILERS*
E - *HEAVY TRAILERS*
F - *FLAT BED TRUCKS*
G - *PICKUP TRUCKS*
H - *AUTOMOBILES*
I - *OTHER*

(See Figure 2-5 for numerical totals for Cubic Yards, Tons and Vehicles.)

COMPARING THE
SEVERAL VEHICLE TYPES
FOR WASTE QUANTITIES
AND VEHICULAR TRAFFIC

FIGURE 2-6



HAULER TYPES

A-*GENERAL CONTRACTOR - (General construction wastes)*
B-*WRECKING CONTRACTOR-(General demolition wastes)*
C-*PAVING CONTRACTOR -(General allied paving wastes)*
D-*COMMERCIAL - DOMESTIC-(Commercial route system, residential portion)*
E-*COMMERCIAL - COMMERCIAL-(Commercial route system, commercial portion)*
F-*COMMERCIAL - INDUSTRIAL-(Commercial route system, industrial portion)*
G-*PRIVATE - COMMERCIAL -(Private single source, commercial establishments)*
H-*PRIVATE - INDUSTRIAL- (Private single source, industrial establishments)*
I-*CITY REFUSE -(Residentil route system, general kitchen and domestic wastes)*
J-*OTHER CITY VEHICLE -(General city and street wastes)*
K-*PRIVATE CITIZEN -(General extraneous domestic wastes)*

(See Figure 2-5 for numerical totals for Cubic Yards, Tons and Vehicles.)

COMPARING THE
SEVERAL HAULER TYPES
FOR WASTE QUANTITIES
AND VEHICULAR TRAFFIC

FIGURE 2-7

Again, the automobile appears as the high traffic and low quantity category.

5. Comparing the Seven Days of the Week for Waste Quantities and Vehicular Traffic. Figure 2-8 shows that the quantities and traffic are reasonably uniform from Monday through Friday with Monday being slightly greater. Saturday shows a reduced volume and tonnage but increased vehicular count. This can be explained by the reduced commercial, industrial and municipal activity and an increase in personal hauling. Reference to the detailed data shows that a high percentage of the Saturday and Sunday traffic is automobiles.

The recommendations for operation of new landfill sites include closing the new site on Sunday; however, the special facilities for automobiles can be left open to the public on Sunday.

6. Comparing the Hours of the Day for Waste Quantities and Vehicular Traffic. Figure 2-9 shows that the peak hour for volume, tonnage and vehicle count is 1500 hours (3:00 P. M.). The second highest peak is 1100 hours.

The quantity and traffic are low prior to 0800 and after 1800 hours. Some of the sites are not open before 0800 and close before 1800 hours; however this chart indicates no large demand for service during these late hours

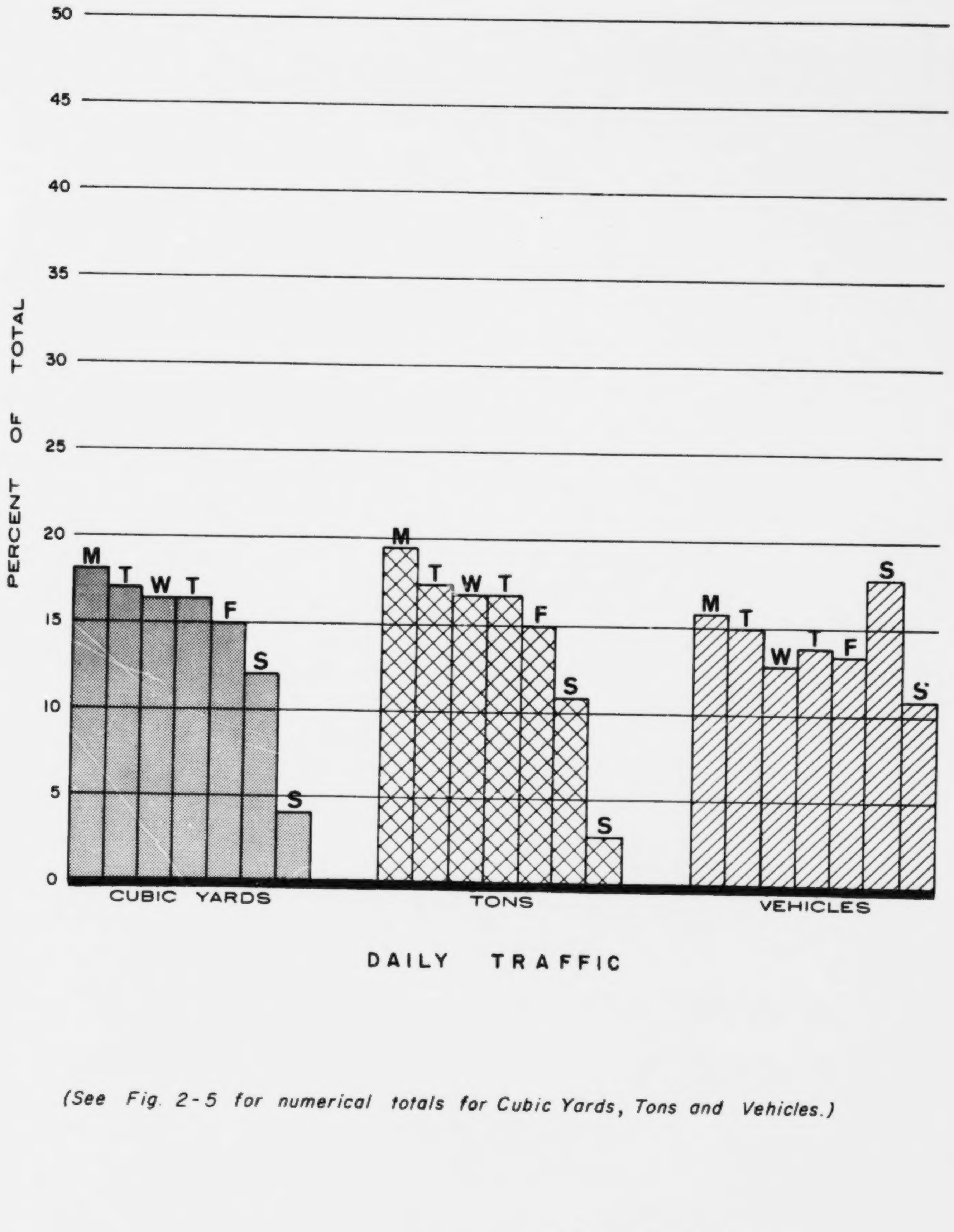
Notice there is no large backlog waiting at 0800. If there was such a backlog there probably would be a dropback between 0700 and 0800 or 0800 and 0900. Instead there is a continuing increase until 0900 before the rate slackens, but even then continues to increase. Similarly the rate begins to slacken at the peak of 1500 and continues down through the 2000 hours.

Our recommended hours for landfill sites are from 0800 to 1700 hours. Special arrangements can be made for haulers inconvenienced by this schedule similar to the arrangements now in existence at several sites.

7. Comparing the Hours of the Day and the Vehicular Count for the Several Types of Vehicles. Figure 2-10 shows the traffic pattern throughout the day by vehicle type.

With the exception of the packer trucks, most vehicle patterns are typical. There is a gradual buildup, a relatively constant rate and gradual reduction. The peak for packer trucks can be explained by the fact that most city packers take their last load to the site at approximately 1500 hours (3:00 P. M.).

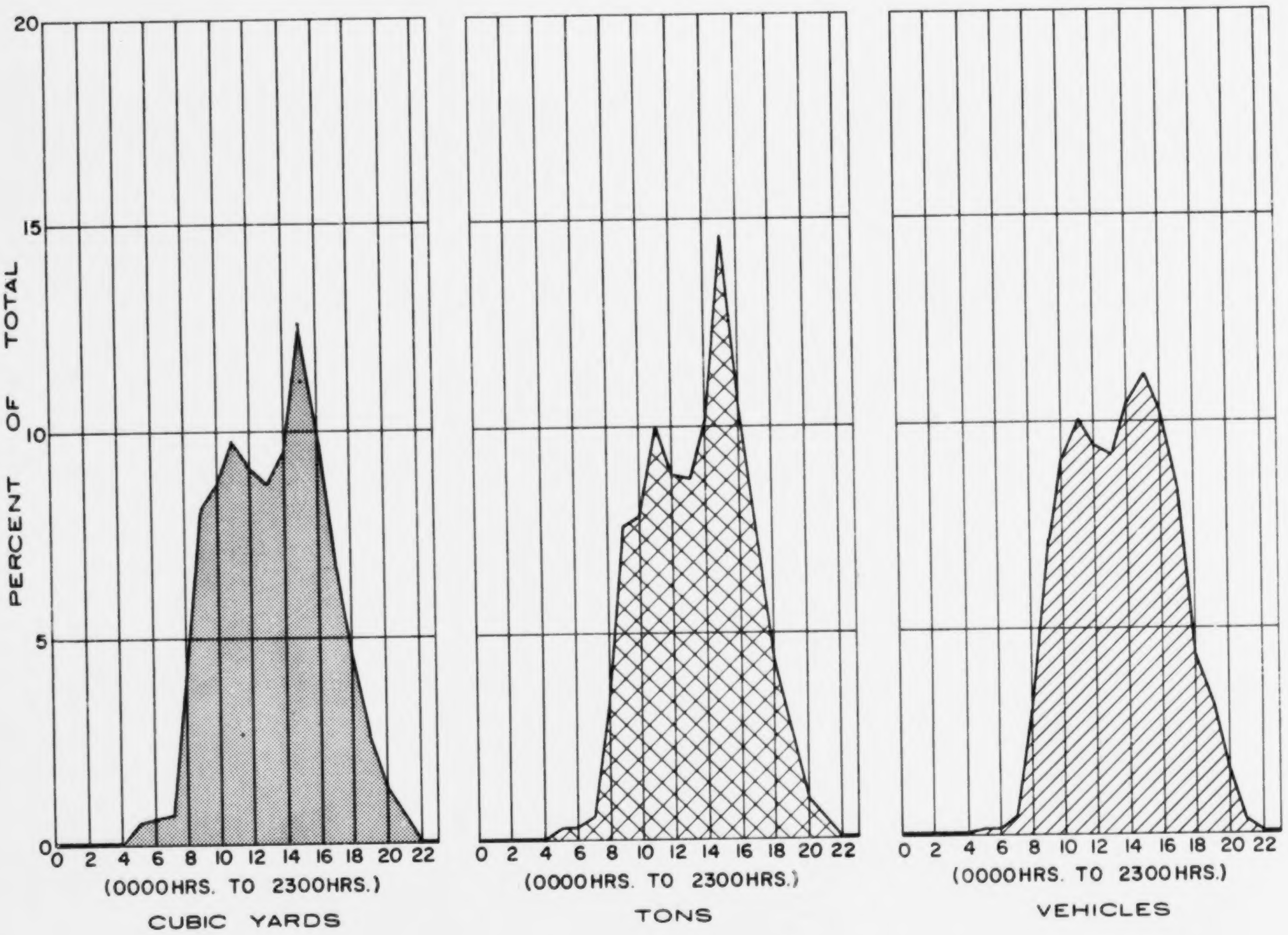
8. Comparing the Various Material Classifications, one with another for Volume and Weight. Exhibits 2-19 thru 2-25 show the volumes, weights and percentage for each material classification. The first six exhibits are for one site each, the seventh, Exhibit 2-25, is for all sites, all days. The key to the material classifications numbering system is shown in Table 2-7.



(See Fig. 2-5 for numerical totals for Cubic Yards, Tons and Vehicles.)

COMPARING THE
SEVEN DAYS OF THE WEEK
FOR WASTE QUANTITIES
AND VEHICULAR TRAFFIC

FIGURE 2-8

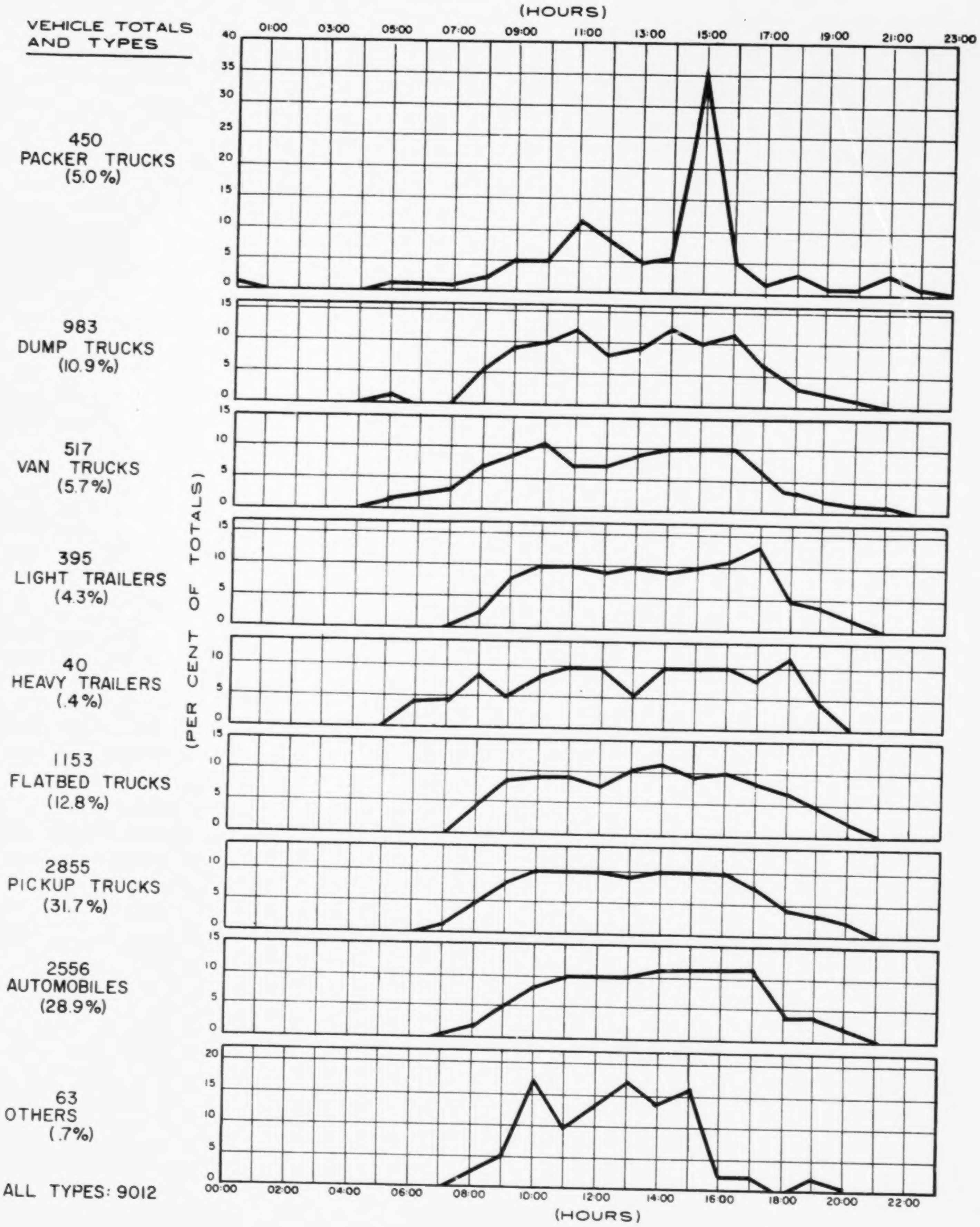


HOURLY TRAFFIC

(See Figure 2-5 for numerical totals for Cubic Yards, Tons and Vehicles.)

COMPARING THE
HOURS OF THE DAY
FOR WASTE QUANTITIES
AND VEHICULAR TRAFFIC

FIGURE 2-9



COMPARING THE HOURS OF THE DAY AND VEHICULAR COUNT FOR THE SEVERAL TYPES OF VEHICLES

FIGURE 2-10

G. Origin of Landfill Wastes

1. Centroids. Computer Program G determined the centroid of waste for each material classification, the sum of all days for each site and for all days at all sites. The centroid is the theoretical point from which the material originated. These centroid are platted on the map in Figure 4-1. The centroid for the sum of all days and all sites, which includes all material brought to the six sites surveyed, was found to be located near the intersection of Seventh Street and Laurel Ave.

2. Vehicle License Registration. Computer Program I determined the amount of material brought to the sites surveyed, according to the county in which each vehicle was licensed. This information is shown in Table 2-8. Approximately 97% of the volume and 95% of the tonnage was delivered to the site in vehicles registered in Polk County. The next largest amount was Warren County registered vehicles with .8% and 2.8% respectively.

3. Political Subdivision as Origins of Waste. Computer Program G determined the political subdivision from which each load originated as determined by the coordinates representing the address of origin recorded during the site surveys. This information is shown in Table 2-9.

Table 2-8
Comparison of Wastes as Received from Vehicle Registration Data
Computer Program I

Vehicle License Code	County	Cubic Yards	% of Total	Tons	% of Total
00	Non-resident	732	1.5	185	1.6
25	Dallas	51	.1	13	.1
27	Decatur	37	.1	9	.1
77	Polk	45,749	96.6	10,863	94.6
82	Scott	77	.2	10	.1
85	Story	53	.1	21	.2
91	Warren	383	.8	317	2.8
--	(42 Others)	269	.6	18	.5
Totals		47,351	100.0	11,480	100.0

Table 2-9
Comparison of Wastes as Received from Political Sub-Divisions
Computer Program G

Political Sub-Division		Cubic Yards	% of Total	Tons	% of Total
1	Des Moines	39,965	84.4	9,524	83.0
2	West Des Moines	3,344	7.1	1,074	9.3
3	Altoona	76	.2	12	.1
4	Ankeny	1,207	2.5	284	2.4
6	Clive	154	.3	35	.3
9	Urbandale	634	1.3	136	1.2
10	Windsor Heights	415	.9	75	.7
13	Polk County (unincorp)	1,341	2.8	293	2.6
	(18 Others)	215	.5	47	.4
Totals		47,351	100.0	11,480	100.0

H. Present Quantities

1. General. The present quantities of solid waste consist of those materials now being disposed of at public landfill sites which were measured during the landfill surveys, and those materials being accumulated or disposed of at the source. The latter quantities are referred to as "on site" disposal materials.

In Table 2-10 "Annual Quantities and Accumulations of Refuse for Study Area, Adjusted for Compaction and Seasonal Variations", the materials measured at public landfill sites are shown in line a. The on site disposal has been evaluated and those materials which will probably be disposed of at public facilities in the future are shown in line b. The sum of lines a and b represent the 1967 estimated annual rate of disposal of materials which can be expected to be disposed of at public landfill sites. The volumes are adjusted for seasonal variations and compaction factors and are equal to the volume of material compacted in place in a sanitary landfill. Cover earth is not included. The tonnage has been adjusted for seasonal variation.

In this table, all of the waste for the study area has been placed in one of four categories: Municipal Wastes, Domestic Wastes, Special Tree Wastes, and Commercial and Industrial Wastes. This was done to facilitate future projection which are discussed in Paragraph I.

2. Municipal Wastes. The wastes included in this category are those which vary directly with the size of the city and the number of people, and are not likely to have a per capita increase. People waste materials at an increasing rate per person; however, the materials which are included in this category are likely to increase at a straight line rate in direct proportion to the population.

TABLE 2-10

ANNUAL QUANTITIES & ACCUMULATIONS OF REFUSE FOR STUDY AREA, ADJUSTED FOR COMPACTION & SEASONAL VARIATIONS

YEAR	POPULATION	MUNICIPAL WASTES		DOMESTIC WASTES		SPECIAL TREE WASTES		COMM./INDUS. WASTES		TOTAL WASTES					VOLUME *
		VOLUME (C.Y.)	WEIGHT (TONS)	VOLUME (C.Y.)	WEIGHT (TONS)	VOLUME (C.Y.)	WEIGHT (TONS)	VOLUME (C.Y.)	WEIGHT (TONS)	VOLUME (C.Y. x 1000)	VOLUME (ACRE FEET)	ACCUMULATED ACRE FEET	WEIGHT (TONS x 1000)	ACCUMULATED TONS x 1000	AS RECEIVED C.Y. x 1000
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
a		180,000	159,000	173,000	59,000	165,000	94,300	308,000	149,000	826	512		461		2,020
b		55,000	51,500	80,000	15,000	16,200	9,200	38,900	24,700	190	118		100		465
1967	287,900	235,000	210,500	253,000	74,000	181,200	103,500	346,900	173,700	1,016	630	630	562	562	2,489
1968	293,600	239,700	214,700	263,100	77,000	304,000	174,000	360,800	180,600	1,168	724	1,354	646	1,208	2,861
1969	299,200	244,400	218,900	273,200	79,900	304,000	174,000	374,700	187,600	1,196	741	2,095	660	1,868	2,930
1970	304,900	249,100	223,100	283,400	82,900	304,000	174,000	388,500	194,500	1,225	760	2,855	675	2,543	3,001
1971	310,500	253,800	227,300	293,500	85,800	304,000	174,000	402,400	201,500	1,254	777	3,632	689	3,232	3,072
1972	316,200	258,500	231,600	303,600	88,800	304,000	174,000	416,300	208,400	1,282	795	4,427	703	3,935	3,141
1973	321,800	263,200	235,800	313,700	91,800			430,200	215,400	1,007	624	5,051	543	4,478	2,467
1974	327,500	267,900	240,000	323,800	94,700			444,000	222,300	1,036	642	5,693	557	5,035	2,538
1975	333,100	272,600	244,200	334,000	97,700			457,900	229,300	1,064	660	6,353	571	5,606	2,607
1976	338,800	277,300	248,400	344,100	100,600			471,800	236,200	1,093	678	7,031	585	6,191	2,678
1977	344,400	282,000	252,600	354,200	103,600			485,700	243,200	1,122	696	7,727	599	6,790	2,749
1978	350,100	286,700	256,800	364,300	106,600			499,500	250,100	1,151	714	8,441	614	7,404	2,820
1979	355,700	291,400	261,000	374,400	109,500			513,400	257,100	1,179	731	9,172	628	8,032	2,889
1980	361,400	296,100	265,200	384,600	112,500			527,300	264,000	1,208	749	9,921	642	8,674	2,960
1981	367,000	300,800	269,400	394,700	115,400			541,200	271,000	1,237	767	10,688	656	9,330	3,031
1982	372,700	305,500	273,700	404,800	118,400			555,000	277,900	1,265	784	11,472	670	10,000	3,099
1983	378,300	310,200	277,900	414,900	121,400			568,900	284,900	1,294	802	12,274	684	10,684	3,170
1984	384,000	314,900	282,100	425,000	124,300			582,800	291,800	1,323	820	13,094	698	11,382	3,241
1985	389,600	319,600	286,300	435,200	127,300			596,700	298,800	1,351	838	13,932	713	12,095	3,310
1986	395,300	324,300	290,500	445,300	130,200			610,500	305,700	1,380	856	14,788	727	12,822	3,381
1987	400,900	329,000	294,700	455,400	133,200			624,400	312,700	1,409	874	15,662	741	13,563	3,452
1988	406,600	333,700	298,900	465,500	136,200			638,300	319,600	1,438	892	16,554	755	14,318	3,523
1989	412,200	338,400	303,100	475,600	139,100			652,200	326,600	1,466	909	17,463	769	15,087	3,592
1990	417,900	343,100	307,300	485,800	142,100			666,000	333,500	1,495	927	18,390	783	15,870	3,663

a AS MEASURED AT LANDFILL SUB-TOTAL 1967

b ADDITIONAL MATERIAL DISPOSED OF ON SITE SUB-TOTAL 1967

* ADJUSTED FOR SEASONAL FACTOR, BUT NOT FOR COMPACTION.

Included in the Municipal Waste category are the materials shown in Table 2-11. Part A is the total material as measured during the landfill surveys less the special tree waste. Part B is the additional material now being disposed of on-site which should be included in the total materials to be expected at a public sanitary landfill facility.

Table 2-11
Municipal Wastes

A. Materials as Measured at Public Landfill Site

Mat'l*** Class		Per Week CY**	Per Week LBS*	Per Year CY**	Per Year LBS*
1		348	1,043,611		
2		1,484	1,272,297		
3		541	1,643,282		
4		6	23,204		
5		132	483,717		
6		378	875,091		
7		52	132,994		
	Sub Total	2,941	5,474,196	153,000	285,000,000
10		1,350	1,823,131		
11		682	920,468		
12		78	62,340		
13		1,590	1,430,875		
	Sub Total	3,700	4,236,814	192,000	220,000,000
70		3	5,862		
71		--	--		
72		--	--		
73		5	8,224		
	Sub Total	8	14,086	416	730,000
	Less Special Tree Waste			-165,000	-189,000,000
	Total Municipal Waste as Measured at Public Landfill Sites			180,000	317,000,000 159,000 tons

B. Material Disposed on Site to be Included in Public Site

Total Sewage Solids	55,000	51,500 tons

C. Total Municipal Wastes 1967 Rates 235,000 210,500 tons

*Adjusted for seasonal variation.
**Adjusted for seasonal variation and compaction
***See Figure 2-4 for material types.

3. Domestic Waste. The waste in this category includes garbage, rubbish and yard waste from the dwellings in the Study Area. These wastes are shown in Table 2-10. The quantities measured at the landfill site were 173,000 cubic yards or 59,000 tons. The on site disposal estimates were 80,000 cubic yards or 15,000 tons, for a total 1967 disposal rate of 253,000 cubic yards or 74,000 tons. These quantities were previously explained in Section C of this Part.

4. Special Tree Waste. The Dutch Elm disease has killed many American Elm trees in the Study Area and will probably continue until most of the remainder have been killed. The quantities of waste wood which are the result, are developed and discussed in Section D of this Part.

Special Tree Waste was considered a separate category in Table 2-10 because of the large quantities involved and because the quantities will last for a relatively few years. It is estimated that almost all of the American Elm trees will be killed by 1970 and that because of the hazard of standing dead trees, most of them will have been disposed of by 1973.

Special tree waste and normal tree waste were not considered separately during the landfill surveys. The total tree wastes were; however, measured. From the special tree waste study,it is estimated that 94,300 tons or 165,000 cubic yards were hauled to landfill sites in 1967. This quantity was subtracted from the total tree waste as measured at landfill sites during surveys to determine the amount of normal tree waste to be included in the Municipal Waste Category. It was also estimated that 92,000 tons or 16,200CY of this special tree waste was burned on site. The amount of material measured at the landfill sites and the amount of material burned on site equal a total of 103,500 tons or 181,200 cubic yards.

5. Commercial and Industrial Waste. This category of waste includes all waste not included in the previous three categories of: Municipal, Domestic and Special Tree Wastes. The quantities are shown in Table 2-12.

That portion of the total measured during the landfill surveys is shown in line C.

In the Commercial and Industrial Surveys described in Section B of this Part, it was estimated that the 1967 on site disposal which can be expected to be sent to public facilities was equal to 9% of the present quantities which were being disposed of at public facilities. These quantities are shown in line D. The on site disposal of meat packing waste as discussed in Section D of Part Two must also be added to the on site total. These are shown in line D.

The Total Commercial and Industrial Waste for 1967 was 346,900 CY or 173,000 Tons.

Table 2-12
Commercial and Industrial Wastes

	Item		C.Y. per Year**		Tons per Year*
A.	Total Waste measured at landfill sites during surveys				
	15,881 CY per wk x 52		826,000		
	$\frac{17,719,824 \text{ lbs per wk} \times 52}{2000}$				461,000
B.	Deducting Non Comm. & Ind.				
	Municipal	180,000		159,000	
	Domestic	173,000		59,000	
	Special Tree	165,000		94,000	
			-518,000		-312,000
C.	Total Comm. & Ind. as measured during Landfill Surveys		308,000		149,000
D.	On site Disposal of Comm. & Ind. @ 9%	27,700		13,400	
	Packing House Waste	11,200		11,300	
			38,900		24,700
E.	Total 1967 Public Site Waste		346,900		173,700

*Adjusted for seasonal variation.

**Adjusted for seasonal variation and compaction.

6. Total Present Waste Quantities.

The sum of the wastes by major categories is shown in Table 2-3. This represents the total solid waste of the community which can be expected to be disposed of at public facilities, at the 1967 rate.

The total quantities are 1,016,000 cubic yards adjusted for compaction and seasonal variation or 562,000 tons adjusted for seasonal variation.

I. Future Quantities

1. General. Future quantities are estimated based on annual increases in the present quantities. The major categories of present waste and the annual estimated increase are as follows:

Municipal - 2%
Residential - 4%
Special Trees - Fixed Quantity
Commercial & Industrial - 4%

The annual quantities and accumulated quantities of waste for 1967 through 1990 are shown in Table 2-10.

2. Municipal Wastes. The wastes in this category are those which vary directly as the size of the community, which is estimated to vary directly with the population. Therefore, the increase in this category is estimated to be 2% per year which is the same as the annual increase in population.

3. Residential Waste. Residential wastes will increase directly as the population increases plus an annual increase in the per capita rate of waste. There are various estimates which predict the rate of increase in per capita waste generation. One such prediction estimates the per capita waste will increase 50% from 1960 to 1985. This is approximately equal to 2% per year.

Long term data are difficult to find and when found are difficult to use, because the conditions under which the data were collected, and exactly what is included is usually unknown. Two percent per year increase appears reasonable; therefore, we have used this rate.

The total increase in annual quantities for residential waste is 2% for population increase and 2% for the per capita rate increase for a total of 4% per year.

4. Special Tree Waste. In the special study of tree waste in Part Two, Section D, it was estimated that 236,000 trees would be removed in the five years after 1967. These trees contained 186,000 tons or 1,520,000 CY of waste. We have arbitrarily estimated that the annual rate of removal would be equal to 20% of the total each year for 5 years. On that basis for each year from 1968 through 1972 we have included 304,000 cubic yards and 174,000 tons.

5. Commercial and Industrial Waste. We have estimated these wastes will increase at a rate which is equal to 4% per year. This is the same rate of increase and is based on the same reasoning given in the preceding paragraph concerning Domestic Waste.

6. Total Waste. The total wastes for future years are shown from the present through 1990, in Table 2-10.

PART THREE - COLLECTION OF SOLID WASTES

A. General. Solid waste collection is a responsibility of the public, along with water supply, sewage disposal, streets, fire and police protection. These services are usually provided by local government, and paid for through taxation or a service charge. It is recognized that a government can provide these services for the public more efficiently and economically than the individual. This part of the report is concerned with collection service as a necessary and desirable element of the community welfare. This service should be as adequate and economical as possible, consistent with current health and aesthetic standards.

B. Basic Collection Systems

1. General. Providing collection service to the domestic customer is the basic consideration. With a Study Area population of approximately 288,000 people, it is estimated that there are approximately 90,000 dwelling units. Each dwelling unit will generate small and reasonably uniform quantities of waste each day, week and year.

Three types of collection systems are presently in use in the Study Area; municipal, contract and private. The three largest cities in the Study Area: Des Moines, West Des Moines and Urbandale operate with the municipal system. Pleasant Hill provides a contract system. The other cities in the area do not provide a direct service, but rely on private system collection service.

2. Municipal and Contract Systems. The municipal and contract systems mentioned are similar. Both are under the control of the municipality. They operate on established routes serving the entire residential areas on a scheduled basis. Under these systems the community receives regular collection of its domestic waste. The system is planned, organized and supervised by the municipal government. The results are an efficient collection service at a reasonable cost to the community.

The basic difference between the two systems is that the municipal system operates the service using its own manpower, equipment and facilities, whereas the contract system uses the manpower, equipment and facilities of a private contractor to operate the system under an agreement between the contractor and the municipality.

The municipality capable of operating its own system efficiently, usually has a lower unit collection cost than the community contracting with private haulers. The municipality can operate the system without a required profit whereas the private contractor cannot. There are other cost factors in favor of a system owned and operated by a municipal government. Tax savings in the purchase of equipment and supplies and in the operational cost of equipment, lower collection costs. A municipally controlled collection system, properly planned and supervised, will provide satisfactory service to the public, whether the system is municipally owned or contracted with a private hauler. The cost to the public is the principal consideration.

3. Private System. With a private system the municipality has a minimum involvement with the collection of waste, limited to controlling ordinances and the licensing of collectors. Some communities do not require either of these items. Private collectors contract directly with the property owner for an agreed fee.

When collections are left entirely to an agreement between the property owner and the private hauler, the service is generally not as efficient as the other systems. The private system places the responsibility for the collection of waste with the individual property owner who may, or may not have a conscientious concern for the problem. Usually several private haulers will compete within a community to provide service. This competition will tend to keep the charges uniform; however it will prevent any one private collector from establishing an efficient route where he can collect from each property in a given area. As a result, the cost to the individual is usually higher than either the municipal or the contract system. A comparison of costs within the Study Area shows this to be true.

4. Recommended System. It is recommended that a municipal type system be provided for all communities in the Study Area. The form of municipal system recommended in the following sections of this report is a new Metropolitan Solid Waste Agency providing collection service to all municipalities in the Study Area using the manpower, equipment and facilities of the Agency.

C. Scope of Collection Service

1. General. The scope of collection service concerns: (1) the customers to be served, (2) the nature of materials to be collected, (3) the frequency of collection, and (4) the point of collection.

Basically it is recommended that: (1) service be provided to all single family residences and certain multiple family dwelling units; (2) all domestic solid waste be collected from these customers; (3) service be offered on a weekly basis; (4) crews collect waste from the place of normal storage of the containers on the customers' premises. These recommendations are discussed in the following paragraphs.

2. Customers to be Served. It is recommended that service be provided to all single family dwellings and small multiple family dwellings only. Commercial and industrial waste generally require special collection service. This waste varies considerably in quantity and characteristics. Private haulers have satisfactorily provided this service in the past and are equipped to do so in the future. However, in the future, when the Agency has been established and has acquired the necessary operating skills and management techniques, the municipalities may wish to consider this service. For the immediate future, it is recommended that private contractors continue to provide commercial and industrial service.

The recommended collection from single family residences and small multiple family dwellings only, was arrived at arbitrarily. The single family residence must be included and represents the largest number of customers. A duplex, fourplex or sixplex, although not as numerous, require similar collection service. Many multiple family dwellings larger than sixplexes do not have adequate storage space when service is offered on a once-a-week basis. Also, many do not want to be burdened with the many refuse cans required for municipal service which does not offer container service. Thus many large units shun public collection and hire private collectors to provide more frequent and/or container service.

It is not a matter of receiving free service. In a later section of this report, it is recommended that the municipalities charge a fee for collection service from those being served. It is basically a matter of who can be served in the most efficient manner along with the single family residence which represents the fundamental reason for a municipal collection service.

Some municipalities do provide complete collection service to any customer who wants the service and is willing to pay a proper fee. However, the task of forming and operating an efficient residential type service for the Study Area, which is a necessity, is a large undertaking for the present. In the future, the Agency when fully operational, may wish to expand service to include more than what is recommended at this time.

3. Material to be Collected. It is recommended that all domestic solid waste be collected subject to certain limitations. This includes all household and yard waste placed in approved containers regardless of the quantity.

The present practice throughout the Study Area is to collect kitchen waste only. This is an old custom which has been abandoned in many communities. This is practical only because combustible rubbish is burned on site, usually in back yard burning barrels. This burning is no longer acceptable in many parts of the country and is often forbidden by ordinance. It is recommended that it be prohibited in the Study Area in a model disposal ordinance included in Appendix Exhibit 5-2.

Burning barrels and inadequate commercial incinerators are a source of smoke, odor and air pollution and often a breeding place for rats and insects. They are not restricted to combustibles such as paper and cardboard but are often fed anything which is not carried away with the kitchen waste collection. There is ample evidence of this through observation of the burned residue in and around these burning devices.

The incidence of fires provide another reason to stop this practice. In the years 1966 through May of 1967, the Des Moines Fire Department fought more than 1900 fires which were directly attributed to burning rubbish. The property damage amounted to $103,000 plus the cost of fire fighting. The potential loss could be considerably greater. There is no estimate of the injuries sustained each year but one can believe it is significant.

There appears to be no reason to allow open burning and inadequate incinerators, once all of the waste from residences is collected along with kitchen waste.

It is estimated that the additional cost of collecting all domestic waste rather than kitchen waste alone, will increase the cost of collection by approximately one-sixth. However, it is believed that improvements in the efficiency of the existing service will result in this cost being absorbed into the existing budget with no increase in funds.

4. Frequency of Collection Service. It is recommended that the frequency of the collection service should be one collection each week on a five day week schedule. This system will provide the Study Area with regular collections with approximately 20% of the area collected each day on a Monday through Friday schedule utilizing the 8 hour work day. This type of schedule is presently employed by most of the collection services in the area. It appears to be acceptable to the householders. Approximately one-half of the communities in the Nation with populations in excess of 5,000 provide this level of service.

In some areas of the country this frequency of service is considered insufficient because of health hazards caused by flies and other insects. It is believed that this problem can be kept at a minimum with a strong program of public education regarding the sanitation requirements for containers and household storage areas. Such a program should be undertaken regardless of the frequency of collections. The cost of a successful program would be much less to the community than the cost of additional collections.

Several studies have been conducted concerning the insect and fly breeding problem. Most of these studies have concluded that the garbage container, and the immediate adjacent storage area is responsible for the majority of the large accumulations of larvae and pupae life of the fly, and that this general unsanitary condition has great bearing on the overall problem.

Proper containers and lids, the cleaning of such containers and the housekeeping of the container storage area, are reasonable requirements to place upon the public. These requirements can be made known to the public by printed instructions along with a public relations program for the entire collection and disposal service. (See Figure 3-1).

It is possible that a twice weekly collection service could be desired and necessary during the summer months if an effective education and enforcement program is not conducted. This service could be coordinated with the once per week schedule during the remaining part

◆ The elimination of burning barrels and the enforcement of reasonable container standards, together with a proper public relations and education program encouraging community clean-up participation, will produce important health and aesthetic dividends for all, as indicated by these picture comparisons.

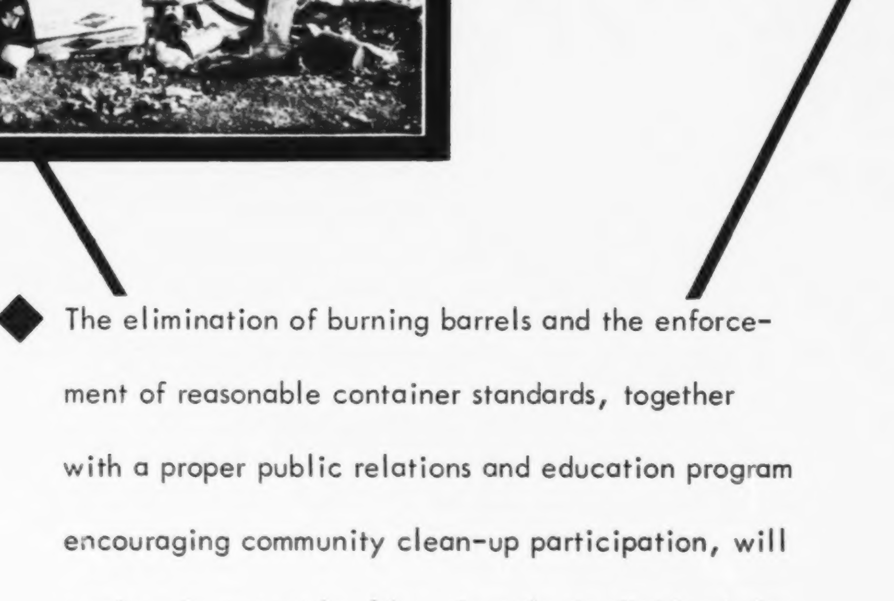


FIGURE 3-1

of the year. The change from a once to twice per week collection and the return, represent a major change in routes, crews and equipment. However, it can be accomplished and is in many parts of the country. This would require an increase in the collection cost but not to the extent that a full year, twice weekly service would require.

5. Point of Collection. It is recommended that the present method of collecting from the waste storage areas behind the customer's dwellings be retained. Collectors convey the waste from the storage area to the vehicle by means of a large capacity, lightweight tote container. This method usually requires only a single trip onto the dwelling premises, and often more than one dwelling can be collected before returning to the vehicle.

There are several other methods used throughout the country other than the one recommended. The most common is the "customer set out and set back" method in which the customer places his containers at the curb or alley line on the scheduled day for collection. The collection crews dump the containers directly into the truck and return the container to the curb or alley line, for the customer to return to the place of normal storage.

This method is less expensive when considering only the collection crew cost. However, the expense and annoyance to each customer must be considered and is sufficient to make this method unattractive. The appearance of rows of waste containers lining the streets and the litter caused by wind, spillage and animals are additional disadvantages.

The current method of collecting from the customer's point of storage is believed proper and is recommended to be continued.

D. Description of Existing Collection Systems

1. General. There are three collection systems operated by municipalities in the Study Area; Des Moines, West Des Moines and Urbandale. All three use their own manpower and equipment to collect domestic kitchen waste from the dwellings within their city limits. Each of the three systems is described in the following paragraphs for the purpose of showing their present status.

It has been recommended that a new Agency be created for future collection of solid waste in the Study Area. However, it is important to improve the existing systems to realize savings and improved services prior to the creation of the new Agency, and to bring to this Agency more efficient organizations.

The three systems are not directly comparable nor can they be organized, managed or operated in the same way. The City of Des Moines is much larger with many crews and trucks. Its organizational structure must be more extensive than those of West Des Moines and Urbandale who operate a two crew and one crew system respectively. The descriptions and analysis which follow deal primarily with Des Moines, with a separate analysis of the other two systems.

2. Description of Des Moines System.

a. Organization, Administration and Personnel. Garbage collection is an activity of the Garbage and Street Cleaning Division, organized under the Public Works Department, and financed from the Sanitation Fund. This Division is under the administration of the Superintendent of Garbage and Street Cleaning Division and under the supervision of the Garbage Collection Supervisor.

The equipment used by the crews is under the control of the supervisor, but is provided and maintained by the Equipment Service Center referred to as "Central Garage" which is also under the Public Works Department. The personnel regularly employed in this system are as follows:

	Function	No.
1.	Garbage and Street Cleaning Superintendent	1
2.	Garbage Collection Supervisor	1
3.	Public Works General Foreman	1
4.	Public Works Foremen	2
5.	Truck Drivers	31
6.	Refuse Collectors	56
	Sub-Total	92
7.	Temporary Employees	6
	Total	98

The employees work 8 hours per day, 5 days per week, 2,080 hours per year, with normal vacation, sick leave, holidays and similar benefits usually found in city employment. Compensation for overtime is granted for work in excess of 8 hours per day, 40 hours per week and Saturdays after holidays, at the rate of one and one-half hours off for each hour worked during the overtime situation; two hours off per hour worked on Sundays and three hours off per hour worked on holidays.

The normal work week is between 7:00 A. M. and 3:30 P. M., Monday through Friday. This schedule is interrupted when the temperature is below zero degrees, except when the schedule is two days behind; or when rain is encountered, and under other inclement weather conditions as directed by the Superintendent.

There are no uniforms, protective clothing or gloves issued to the employees. There are no lockers or clean-up facilities available. The employees are represented by a union.

b. Operations. Domestic kitchen waste is collected once a week from the dwellings within the city limits. Collection does not include trash or rubbish. Service is not provided to industrial or commercial establishments. Occasionally during spring clean-up campaigns the City provides collection of all waste.

Crews operating from streets or alleys empty customers' containers into tote baskets which they carry to the truck. With certain limitations, customers may keep their containers at locations most convenient for themselves. There are prescribed regulations concerning the waste to be collected, wrapping and draining waste and type of container.

The City is divided into 27 collection routes. Each route is divided into approximately 5 equal days work, one day each on Monday through Friday. There are exceptions in many cases; however, most exceptions involve the Friday work where no Friday is scheduled in some routes, or where scheduled, may be less than a day's work. It is intended to use the Friday short routes to collect any problem areas which may have developed in the week's work.

The exact current boundaries of each route are not recorded on maps. The areas, however, are known to the crew involved, some other crews, the area foreman and the Supervisor. The exact path to be driven is left to the option of the driver. This path is not recorded and may vary under normal operations.

Crews consisting of a driver and two collectors start work at 7:00 A. M. at the garbage collection office. They are expected to collect their day's assignment and if completed early, report for additional assignment to assist routes which are behind or give additional collections to areas previously collected as time permits. The driver normally collects waste in addition to his driving duties. Collectors are allowed to drive the truck when on the route. Only the driver is allowed to drive when off the route.

The three foremen, each equipped with a two-way radio between their automobile and the department office, direct the activities of the crews. The crews are permitted a 15 minute break in the morning and in the afternoon. They are also allotted a 30 minute lunch period.

Crews make one or more trips from their routes to the landfill site as required. After their last load, the crews return to the Central Garage where they fuel and park their vehicles. Each driver is required to submit a daily report form recording his activity, time, miles, crew members and collected quantities.

There are no formal programs for health and safety, driver or collector training, or customer relationship. No written "standard operating procedures" could be found. The department has many procedures which are established and generally followed through custom. It is on the basis of these procedures that the department operates.

c. Equipment. Supervisory personnel, including the foremen, are equipped with late model sedan automobiles each with two-way radio communication. The collection crews use single axle, gasoline powered trucks with hydraulic packer type bodies, each with a capacity of 16 cubic yards. There are 31 trucks of this type in the current fleet. It is the policy of the department to amortize the trucks over a 6-year period and replace them with new equipment at the end of the six-years. Basically, 5 new units are purchased each year. The 10 packer bodies purchased in the last two years have been of the hydraulic pushout type. Previous models were of the hydraulic dump type.

Equipment is maintained and repaired by the Central Garage. Garage personnel have custody of the vehicles and issue keys to the drivers each morning and receive the keys back each afternoon. The fleet of 31 packer trucks is adequate to accomplish the collection. Twenty-seven vehicles are used for the 27 routes. Four of the oldest vehicles are used as spares.

One additional truck is included in the collection fleet. This truck is equipped with a container hoisting mechanism, and used from time to time during the week to collect from a few apartments and from the Central Garage.

The equipment used by the garbage collection department is purchased from budgeted sums when first needed. The equipment is amortized over a prescribed period. The cost of maintenance, repair and amortization is calculated into a rental rate. The garbage department budget is charged a rental rate which is credited to the Central Garage Fund. Replacement equipment is purchased from amortization accruals in the Garage Fund.

The cost of maintaining each vehicle is charged to that particular vehicle. This information is maintained for the garage by the Finance Department. Rental rates are established and are the same for all equipment of a like kind. These rates are based on the costs of similar equipment for the complete year preceding the year in which the budget is made. The Garbage Department is responsible for the cleanliness and sanitary conditions of the vehicles.

There is no formal direct liasion between the Central Garage activity and the Garbage Collection Department. There is no formal procedure for determining causes of reoccurring equipment breakdowns except for accidents which are investigated through the police. There is no formal instruction from the Central Garage in the operation of trucks or packers.

d. Costs. The revised budget for the 1967 calendar year was $673,434. Based on a population of 208,000 people, the cost per capita was $3.24 per year. Using 3.0 people per dwelling unit, the cost per dwelling unit is $9.72 per year. All funds budgeted for this service are provided from property taxes. There are no special fees or other income.

3. Description of the West Des Moines System

a. Organization, Administration and Personnel. Garbage collection is the responsibility of the Director of Public Works under the overall direction of the City Manager. The system is small and does not require a detailed chain of command. The work is personally known to the Director of Public Works who takes an active part in conducting the affairs of the collection department. A general foreman is available for daily supervision and the follow-up of complaints and special problems.

There are six full time employees engaged in collection work plus the foreman who devotes part of his time to this activity. When necessary, extra personnel or substitute personnel are supplied from the street department. The employees work 8 hours per day, 40 hours per week, 2,080 hours per year with normal vacation, sick leave, holidays and similar benefits usually found in city employment. Compensation for overtime is on the basis of time and one-half and double time on Sundays. The crews are allowed to discontinue collection during inclement weather at their discretion. They are required to make up lost time at standard pay rate.

The employees are issued uniforms, coveralls and gloves for winter use. Rain suits, lockers and clean-up facilities are available. The employees are not represented by a union.

b. Operations. Domestic kitchen waste is collected once a week from the dwellings within the city limits. Collection does not include trash or rubbish. Service is not provided to industrial or commercial establishments. Occasional clean-up campaigns are conducted during which all waste is collected.

Crews operate from the streets and alleys collecting from the containers stored on the customers' premises. There are prescribed regulations for containers and the waste to be collected.

The City is divided into ten areas, each representing approximately one day's work for a collection crew. Two crews of 3 men each collect the ten routes in five working days, Monday through Friday. The driver collects waste in addition to his driving duties.

c. Equipment. The two collection crews use single axle gasoline powered trucks with hydraulic packer bodies. The two trucks in active service have late model, 16 C. Y. capacity, push-out type bodies. There is a spare truck with a 13 C. Y. side loading, dump type body which is adequate for standby service. It is the policy of the department to amortize the truck chassis on a 5-year basis and the packer body in 8 years. Maintenance is provided by City forces at the City shop.

d. Costs. The cost of operation as determined by the City includes part lump sum appropriations and part annual costs for the trucks. These figures have been adjusted to place them on an annual basis. A figure of $3,000 per year per vehicle has been used as the total cost of owning and operating the trucks. Reconstructed personnel costs including certain overhead expenses, are as follows: Personnel at $437 per month plus 18% for payroll expense plus 8.3% for vacations, sick leave and holidays. New wage rate; $558 per month and for six men is equal to $40,200 per year. To this 10% has been added for direct supervision for a total personnel cost of $44,200.

The cost of operating the collection system for West Des Moines is approximately as follows:

Personnel	$44,200
Trucks, 2 @ $3,000	6,000
Supplies	300
Uniforms	1,000
Total Cost	$51,500

Based on a population of 14,000 people, the cost per capita is $3.68 per year. Assuming 3.5 people per dwelling unit, the cost per dwelling unit is $12.88 per year. All funds budgeted for this service are provided from property taxes. There are no special fees or other income.

4. Description of the Urbandale System

a. Organization, Administration and Personnel. Garbage collection is a responsibility of the City Engineer who also serves as Director of Public Works under the over-all direction of the City Manager.

The system is very small consisting of one driver and 3 collectors who work 4 days per week on this activity. The driver acts as foreman and receives general supervision from the City Engineer.

The employees work 10 hours per day, 4 days per week, plus 2 hours on the 5th day for equipment cleanup, and receive the normal vacation, sick leave, holidays and similar benefits usually found in City employment. Compensation for overtime is on the basis of time off or pay at straight time. Crews are allowed to discontinue collection during inclement weather at the discretion of the foreman with the approval of the City Engineer. Lost time is made up at a standard pay rate. The employees are furnished uniforms and coveralls. The employees are not represented by a union.

b. Operations. Domestic kitchen waste is collected once a week from the dwellings within the City limits. There is no collection of trash or rubbish. Service is not provided to industrial or commercial establishments. Semi-annual clean-up campaigns are conducted during which all waste is collected.

Crews operating from streets collect waste from cans stored on the customers' premises. There are prescribed regulations for containers and the waste to be collected.

The City is divided into 4 routes; one is collected each day Monday through Thursday.

The crew consists of the driver and three collectors. The driver helps pick up waste; however the truck is not left unattended. Of the 4 man crew only 3 collect at any one time.

c. Equipment. The one collection crew uses a late model, single axle, gasoline powered truck with a 16 C. Y. hydraulic push-out type body. A standby truck is available from a local dealer when required.

d. Costs. Truck depreciation has been estimated at $1600 per year. Wage rates are reported on the basis of hourly rates. To these rates 18% has been added for payroll expense and 8.3% for vacation, sick leave and holidays. The reestablished rates are as follows: foreman-driver $3.95 per hour, other crew members $2.95 per hour. On the basis of 2,184 hours per year, the direct personnel cost is $28,000. Supervision has been added at 15% of the direct labor.

The cost of operating the collection system for Urbandale is approximately as follows:

Personnel	$28,000
Supervision	4,200
Truck & Packer Body Depreciation	1,600
Truck & Packer Body Maintenance	500
Fuel and Other Supplies	1,500
Total Cost	$35,800

Based on a population of 12,500 people, the cost per capita is $2.86 per year. Assuming 3.9 people per dwelling unit, the cost per dwelling unit is $11.15 per year.

All funds are budgeted for this service from property taxes. There are no special fees or other income.

E. Analysis and Recommendations for Existing Collection Systems.

1. General. It has been recommended that a Metropolitan Solid Waste Agency be formed to collect all domestic waste in the Study Area. This Agency would integrate into one system the existing collection departments of those municipalities who join the Agency and provide service to other municipalities who join but do not have a system now in operation.

The existing systems have been analyzed to determine where improvements might be possible and appropriate, for two reasons: (1) There are potential savings to be made and improved service to be enjoyed; and (2) the improved systems will be more easily integrated into the new combined effort.

Comments in this section apply and are based primarily on the Des Moines collection department. This department now collects from 75% of the population that would be served by the new Agency, and because of its size has all of the problems, required administration and operation that would be found in the new Agency collection system.

West Des Moines and Urbandale may apply any of the suggestions which they feel applicable to their collection services.

2. Records. Paper work in the form of reports and analysis is a time consuming activity. The information recorded and analyzed must have a need and be worth the trouble and expense. The daily production reports of the Des Moines system, in use at the time this study was begun, were found to be entirely inadequate for planning purposes or as a management tool. Twenty-five hundred of these daily production reports entitled "Garbage - Daily Report," were selected and analyzed by a series of computer programs to test the value of the existing data. The results indicated that much of the information was inaccurately recorded or incomplete. It was determined that the report forms were not designed to provide information necessary to evaluate the system, and that the use of the forms was not properly understood by the men and their supervisors.

To correct this situation, a series of reports and work sheets have been designed and proposed to provide necessary information for the three levels of management:

First Level:	The District Foreman
Second Level:	The Superintendent
Third Level:	The City Executives, including the City Manager and the Director of Public Works

Basic data is recorded by the route driver on the "Drivers Daily Report," which replaces the previously discussed form. This form accounts for the crew activity throughout the day, with time and distances divided into three activities; (1) collection, (2) haul, (3) delay. The driver must make an entry of his mileage reading and the time of day each time he changes his activity. At the end of the day, he must make an entry concerning what he collected, and add up the total. A sample of this form and instructions are included in the Appendix as Exhibit 3-1.

An early version of the "Drivers Daily Report" was designed and proposed for use in June 1967. This report was intended to produce data that could not be obtained from the old report forms. This form was designed to make the arithmetic and concepts easy to understand. The drivers and supervisors were instructed in its use prior to being placed into service as a replacement for the Garbage Daily Report. The information obtained from this form, although better than that produced in the previous reports, was not considered adequate to obtain the required data for this study. The use of this form did provide the men with experience in calculating the time spent on several types of activity and in doing arithmetic similar to that recommended in the new Drivers Daily Report.

The data derived from the "Drivers Daily Report" is recorded on the "Foreman's Daily Recap Work Sheet." There is one sheet for each day of each route within the foreman's district. Each day the foreman records the totals from the "Drivers Daily Report" on the appropriate work sheet. If a driver has indicated on his report that he helped another route that day, the time spent on the other route would be recorded on the work sheet of the route which was helped, but not on the assisting crews work sheet. In this way, the actual work spent on a route can be ascertained. At the end of a month, the totals are calculated. Since some months have more days than others, the months totals are reduced to averages based on the number of collections made during the month.

In order for the foreman to determine the total performance of his District, the recap work sheets for each route and each day are summarized on the "Monthly District Refuse Collection Summary." This summary is coordinated with the recap work sheets and designed to receive the totals from each work sheet.

Using averages per collection allows the foreman to compare the collections each month with other months. A sample of the work sheet and summary, with instructions, are included in the Appendix as Exhibits 3-2 and 3-3.

The Superintendent is concerned with all districts. Totals taken from the District Summaries are recorded on the "Monthly Refuse Collection Summary - All Districts." This is the same data, totals and averages found on the District Sheets and Foreman's Recaps. However, at the bottom of this summary is certain historical data for comparing the current month to previous months. This data is available from previous months reporting. A sample of this summary report for all Districts is included in the Appendix as Exhibit 3-4.

City executives normally are not concerned with the detailed information regarding the performance of various individual routes or districts. They are concerned with overall performance, and the costs of the Division. The "Refuse Collection Report for the Month" is designed to provide this type of information.

Totals and averages from the "Monthly Summary of All Districts" are reproduced for reference, and in addition, total cost and unit cost figures are included. Normally management will be concerned with total cost and unit costs, but may also wish to study the other items for background to understand changes appearing in the cost columns. They may also wish to receive or refer to the reports and work sheets leading to the Monthly Report. Although designed for the management level that normally needs or has the data, any of the reports discussed here should be available to any others who wish to see them. It is suggested that the reports summarizing the crew activities be posted for comparison of performance.

In order for the unit costs to be of value for comparison purposes, it is necessary to charge for labor and equipment on a monthly or hourly basis, rather than on infrequent lump sums. Equipment is charged as a rental each month, based on the number of hours used that month. This is proper and avoids loading any particular month due to large purchases. Rental rates for an hourly or daily use covering purchase, amortization, maintenance, repair and salvage over the life of the vehicle provide a true picture of unit costs which is useful and proper.

Labor rates are not similarly treated. It is recommended that current accounting practice be changed to facilitate the use of these reports. Under the present practice, compensatory time is earned from time to time, but is charged against the month in which it is taken. This is also true of vacations and sick leave. During the popular vacation months, and during the time when casual labor is used, the labor costs appear unusually high. This has nothing to do with the actual labor cost of collecting refuse from the community that month, but only an accounting procedure causing an apparent rise in labor costs.

Employees actually earn vacation time, sick leave and holidays as they work throughout the year. These credits should be accrued and charged against the month they were earned, as opposed to the month expended. Casual labor should be charged against the month worked. In this way, the accounting procedures will give a true indication of the labor cost of work done, and when it is done.

To arrive at a cost of labor for the Monthly Report, provisions have been made to compute the cost per production hour, at the bottom of the report, and to include in this rate the labor and supervision, plus accruals and payroll overheads. A sample of the "Report for the Month" is included in the Appendix as Exhibit 3-5.

Production which is the primary function of the Garbage Collection Department must have properly managed and audited records to operate a system of this size efficiently. A production system must have the ability to acquire and use data in its every day operations.

3. Routes Followed and Observed. Basic data on the performance of collection crews was obtained by placing a technician with the crews to observe performance and record data. The technician followed each crew by automobile during the entire working day. The technician's work was explained to the crew. The men were shown the forms to be used to record data and asked to assist the technican where necessary. During the coffee breaks and at lunch, discussion of the data acquired was encouraged.

On the form shown in the Appendix as Exhibit 3-6, the technician recorded information concerning the path of movement of the truck, the side of the street or alley the crew was collecting, turning movements, the number of stops the truck made, the containers emptied and the time required to collect each block. They also weighed each load brought to the landfill site. In addition, the technician recorded time and mileage information on a Drivers Daily Report. In total, twenty-six full crew days were observed from which performance data was determined.

4. Performance Measured and Analyzed.

a. Collection, Haul and Delay Time. The time spent by each crew while being accompanied by a technician, is shown in Table 3-1. Collection time is time spent while on route collecting waste and driving between stops on the route. An average of 290 minutes was spent in collection.

Haul time is the time spent driving from the garage to the first stop in the morning, driving to and from the landfill site and driving from the landfill site back to the garage at the end of the working day. An average of 65 minutes was spent in haul.

Delay time is the time during the day not spent in either collection or haul. It includes lunch, rest and coffee breaks, mechanical breakdown, waiting at landfill site, spare time at end of day, meetings, etc. An average of 155 minutes per day was spent in delay.

TABLE 3-1

Collection, Haul and Delay Times, (Including Deadheading) As Observed During Route Surveys

Route No.	Survey Date	Collection Time	Haul Time	Delay Time
1a	8/28	4:47	1:31	2:12
1b	9/1	4:30	1:40	2:20
2	6/22	5:15	1:20	1.55
3	8/23	5:15	1:25	1:50
4	8/14	5:19	:35	2:46
5	6/26	5:15	1:16	1:44
7	8/15	4:11	:45	3:34
8	8/30	3:52	:59	3:39
9	8/30	5:09	:33	2:48
10	8/16	5:12	:46	2:32
11	8/24	3:23	1:47	3:20
14	6/28	5:17	:50	2:23
15	8/23	5.24	:54	2:12
16	8/29	4:01	:33	3:56
17	6/23	5:42	:59	1:49
18	8/24	4:25	1:25	2:40
19a	6/22	4:26	1:37	2:37
19b	9/1	4:23	1:01	3:06
20	8/25	4:20	1:07	3:03
21	8/18	4:11	1:06	3:22
22	6/22	5:30	1:00	2:00
23	8/21	5:10	1:02	2:18
24	8/28	5:11	:33	2:46
25	6/2	5:06	1:26	2:08
26	8/22	5:30	1:05	1:55
27	6/22	5:10	1:00	2:20
Total		125:54	28:15	67:15
Avg.		4:50	1:05	2:35
Avg. Min.		290	65	155

b. Existing Routes Mapped. Maps were prepared showing how each route was driven according to the usual practice. The base maps were prepared by a technician with the aid of the driver and his foreman. Each driver was requested to describe how the route was normally driven. The technician recorded this information which indicated one side or two side collections, all turns and movements, deadheading, lunch and coffee break points and other pertinent information. The paths normally driven were worked out on the ground without the benefit of maps. Numerous examples of unnecessary deadheading and side street collection became apparent by inspection.

There are situations that appear to be complicated but are actually necessary. These are caused by one-way streets and alleys, median strips and steep hills.

Prior to this study, the detailed routes had not been mapped. The crews assigned to the route knew them and some crews were familiar with more than one route. Likewise, the supervisors were well acquainted with most of the details of the routes. However, if necessary to assign new men to a route, the instructions had to be given verbally or written down. In the case of the loss of several of the crews, the replacement problem would be very difficult. These maps are available to the supervisors for reference. New routes have been laid out and are discussed in a following paragraph.

Skill in the use of maps is essential to maintain route efficiency. It is recommended that supervisory personnel be trained to use map techniques and see that they are used by the crews.

c. Routes as Observed, Compared to Mapped Routes. The routes actually driven by each crew, as recorded by the technician accompanying the crew, were compared to the maps of the routes as the driver had said they were normally driven. Sometimes they followed the routes very closely. Frequently they did not. In most cases the crew, while being observed, covered not only the scheduled day's route but parts of other days as well. The average production of all routes followed was 127% of a scheduled day's work. A summary of each collection route is included in the Appendix Exhibit 3-7.

d. Analysis of Routes Followed. The average crew spent 290 minutes in collection, 65 minutes in haul and 155 minutes in delay to collect their route, as shown in Table 3-1. In addition the average crew not only finished what had been scheduled as a day's work but also collected 27% of another day's work. In doing so they spent 155 minutes in delays. It is apparent that the routes as now laid out, assigned and manned, do not represent a day's work.

If the crews had stopped work as soon as one day's work, as assigned, was completed and charged the remaining time to delay, the delay would be much larger than it was. Together, the long delay and the more than adequate collection time, represent a very significant potential saving. In later paragraphs, the possible reduction in crews and equipment is discussed and estimated. It appears that the savings in crews and equipment should be in the range of approximately one-third.

The information from the observations was analyzed and recorded in the Appendix Exhibit 3-8, "Collection Survey, Sheets 1 thru 6." The information was first broken down into 4 major collection conditions:

1. From an alley on one side only.
2. From an alley on two sides.
3. From a street on one side only.
4. From a street on two sides.

The miles of each collection condition were determined by measuring each block of each condition from maps and summarizing these distances by collection-condition. Miles determined in this manner are collection miles excluding deadheading. New route layouts will have only minor amounts of deadheading, therefore this influence was eliminated.

Time, stops, and containers were taken from observations for that block. The time excluded deadheading. The dwelling unit count was taken from land use maps developed by the city. The weight of the day's route was the weight of one or two loads as appropriate from actual weighings.

For each route, unit factors were determined as indicated. These units were on a "per mile," "per stop," and "per dwelling unit" basis. The per mile factors were used in analyzing existing routes and setting recommended standards. The per dwelling unit and per stop factors were not used.

5. New Work Rules. It is apparent that new work rules must be established and enforced. It is recommended that the "incentive" or "task" system be used. This system, and the explanation of other terms mentioned in this paragraph on work rules, is explained in a letter to the Director of Public Works dated August 30, 1967, which is reproduced in the Appendix as Exhibit 3-9.

The incentive system, which is in common use throughout the United States is simply assigning the men a certain amount of work to be accomplished each day. When they have completed the work they are permitted to go home. The incentive for fast work is time off at the end of the day. We have designed the recommended routes in District #1 to allow a 40 minute incentive at the end of the day, provided the men work steadily and at a reasonably fast pace.

We have also allowed a 5 minute rest break each hour except when a haul or lunch or other break occurs. See Exhibit 3-9 for a sample day.

A scheduled lunch period is included in the day's work. This period should be adequate to go to a place to wash and eat. Currently 30 minutes is scheduled and the crews are allowed to go to the nearest fire station or City park to eat. This appears to be appropriate and popular with the men; however the lunch periods are seldom restricted to 30 minutes. It should be agreed that either 30 minutes are to be used and then limit the crews to this time, or schedule a longer period for lunch and extend the work day to cover this period.

The following is a summary of the work rules which are explained in Exhibit 3-9:

SUGGESTED NEW WORK RULES

a. At the beginning of the day, collection crews shall proceed directly from the yard to the point of first collection where they will begin collection of waste.

b. Crews shall remain on their routes and shall follow the prescribed path at all times except when proceeding to and from the place of disposal and the yard and except for the lunch period.

c. One 30 minute lunch period, which starts when the crew leaves their route and ends when they have returned to their route, may be taken. Crews may leave their route during this period and drive to the nearest City fire station or City park

d. At the end of any full hour's collection time the crew may take, and they are encouraged to take, a 5 minute rest break; except when it is time to go to lunch or the truck is full and they should proceed to the place of disposal.

e. When the route has been collected the crew shall proceed directly to the place of disposal and then directly to the yard, at which time they normally will be dismissed for the day.

f. If one or more of the collection crews in the same district have been delayed for any reason, the District Foreman may direct one or more of the other crews in that District to assist a delayed crew with the completion of the delayed crews collection.

g. When a crew is required to work more than the 8 hours per day plus lunch time, they shall receive compensatory time off, at another time, at the rate of 1-1/2 hours of compensatory time for each one hour of time worked in excess of the 8 hours plus lunch time.

6. New Standards. In order to lay out new routes and determine the number of crews and trucks, certain standards of performance must be determined. Standards are necessary for three types of activities; collection, haul and delay.

a. Standards for Haul. The standards for haul include the estimated time required to drive the following distances for each route:

(1) From garage to first stop on route in the morning.

(2) From route to landfill site.

(3) From landfill site back to route.

(4) From landfill site to garage.

The foreman should determine the routes with the shortest driving time and instruct his crews to use them.

b. Standards for Delay. Standards for delay consist of the following:

(1) Rest break.

(2) Lunch break.

(3) Incentive time.

(4) Unloading time at landfill site.

(5) Mechanical breakdown.

(6) Other stoppage of collection or haul.

Items (1) and (2) are based on the work rules, and are scheduled into the day's activity.

Item (3), Incentive time, is estimated to be 40 minutes, but will vary with the crew and other influences.

Item (4) is estimated to be 5 minutes.

No special allowance is made for items (5) and (6). They are unusual happenings, and if they occur they reduce the incentive time. With an incentive system, the incidence of flat tires discovered in the morning, which could have been discovered at the end of the previous day, will diminish markedly. Similarly, the crews will be more alert to potential mechanical breakdown in their vehicles, and are likely to report them before a delaying breakdown occurs. Standards for delay will be based on the new work rules outlined previously.

c. Standards for Collection. Standards for collection are based on the average performances of the crews as measured. The standards are approximate because they are guides which must be applied to varying circumstances. They can be used to design routes which will be reasonably correct on the average but will require adjustment to compensate for unusual conditions. These unusual conditions could involve the type of street or alley, frequency of fences, population density, difficult terrain and similar items.

The standards also must be reevaluated once the recommended routes are established. How the standards were derived and the reason for the required reevaluation are discussed in the following paragraphs.

The routes in their present condition are sufficiently confused to make the measurement of performance difficult and unreliable except for approximations. It was shown that normal routes were not always followed; more than one day's work was collected when the crews were observed; the path driven over a route had large amounts of deadheading; parts of routes covered may have been collected less than a week before, resulting in light collections, or more than one week before resulting in heavy collection and the crews performance was probably influenced by the presence of the observer. It is necessary to improve the routes and procedures before they can be measured with any degree of reliability.

To develop temporary standards for the improved routes, city-wide averages were used for the four collection conditions. These averages and the temporary recommended standards are shown in Table 3-2.

Table 3-2

Collection Standards, Minutes Per Mile

		City Average	Recommended (3-man Crew)	Recommended (2-man Crew)
1.	Alleys, one side	45.1	50	82
2.	Alleys, two sides	59.8	63	103
3.	Streets, one side	46.2	48	79
4.	Streets, two sides	56.8	65	106

Prior to developing the temporary standards, trial standards were set using the average minutes per mile observed for crews operating in the northwest 1/3 of the City which is referred to as District I. These standards and those for delay and haul were used and routes were designed on a first trial basis to cover the area north of the freeway and west of the Des Moines River. The resulting routes were compared to the present routes in the area. The new trial routes required a total of 77 man-days as compared to 136.5 man-days for existing crews now covering the same area.

This comparison would indicate that manpower requirements could be reduced to 57% of the existing forces. However, it would be unrealistic to say that the Des Moines system could reorganize into an efficient system with a collection work force of only 57% of its present strength, based on the averages for the routes observed in District I. The data is not that exact. It is proper to say that the trial routes indicate that substantial reductions can be made in the work forces.

New and liberal standards have been used for the recommended routes. City-wide averages were used as a base as opposed to averages in the District I area due to having more data available. Using city-wide averages based on 26 routes, representing approximately 20% of the total routes, the data is more representative.

Basing the standards on observed performance while the men were actually collecting is realistic. The crews probably worked more steadily and faster than normal; however, the principal of incentive time is based on reward of time off for steady fast work. On the average, the production accomplished when the men were collecting was considered adequate. Improvements can be made in production, not involving additional efforts by the crew. These improvements are discussed elsewhere.

The production standards used for the recommended routes are shown in Table 3-2. These standards were made more liberal than the averages, by allowing more time per mile of collection. This was done for the following reasons:

1. The scope of the reorganization and improvements is too large to accomplish in one step.

2. The data is not sufficiently accurate to apply directly.

3. The new liberal standards will be only temporary. Once the new routes and conditions have been installed and are functioning as an efficient system, the routes should be remeasured and new standards applied as appropriate. This procedure and other adjustments to standards are discussed in Section E-7. New crew requirements are shown in Section E-8.

Collection standards are shown for three-man crews and two-man crews. A three-man crew will require two trips to the landfill site. A two-man crew, if equally efficient per man, would collect only 2/3 as much material and make only one trip to the landfill site. This represents a considerable savings because the time saved by eliminating a round trip will be used for additional collection.

Additional equipment is necessary for two-man crews. For each six men, the three-man crew requires 2 trucks and the two-men crew requires 3 trucks. There is a driving time for the round trip to the landfill site which represents a break-even point. The break-even time has been determined to be 22.5 minutes. The computations necessary to establish this time are shown in Appendix Exhibit 3-10.

In District I routes, two-man crews were used where the driving time was greater than 22.5 minutes.

7. New Routes Established. New routes have been established for approximately 1/3 of the City in the area west of the Des Moines River and primarily north of the Freeway, referred to as District I. It extends below the expressway only for a small area necessary to finish out the full 5 days of the last route.

Starting in the northwest corner of District I a map was drawn of an efficient driving path which, if followed, would lead the collection crews along all of the streets and alleys required to provide collection of all of the domestic solid waste area. The path has been designed and field checked to eliminate unnecessary deadheading and takes into account one-way streets, deadends, median strips and similar barriers. This map is shown as Figure 3-2. A description of the path is given in the District I Route Book. In this book the 1490 city blocks from which collection is made in District I are described. A sample page from the route book is shown as Figure 3-3.

The routes were designed using the standards and work rules described in the preceding sections. The design is basically applying collection time standards to the distances and conditions listed in the route book and adding the haul and delay times, as appropriate, until a day's work has been accomplished.

Each route has been designed and recorded in a Route Plan Book. The Route Plan Book for District I is complete and is available for use. It is not reproduced in this report, but a sample of the first day's route is included as Figure 3-4.

A summary of the routes in District I is given in Table 3.3.

Each crew assigned to District I should be given a copy of the Route Book for District I. Their assigned routes are given by block numbers. For example, Route 1, Day 1 is from Block 01 through Block 14. Route 1, Day 2 is from Block 15 through Block 38, etc.

DISTRICT I ROUTE 1 DAY 1 2 MAN CREW 16 C.Y. TRUCK DATE COMPUTED 1/3/68 BY MKC PAGE NO. 1

SAMPLE PAGE
ROUTE PLAN BOOK

FROM DISTRICT ROUTE BOOK					ST'D.	COLLECTION		HAUL	DELAY	CUMULATIVE		REMARKS
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
BLOCK NO		DIST FT	DU EA	COND	RATE MIN/MILE	DIST MILES	TIME MIN	TIME MIN	TIME MIN	TIME MIN	WT. LBS	
FROM	TO											
								25		25		TO ROUTE
01		1320	8	S-1	79	.25	20			45		
02	03	2640	78	S-2	106	.5	53			98		
									5	103		BREAK
04	05	2640	63	S-2	106	.5	53			156		
									5	161		BREAK
06	07	2640	69	S-2	106	.5	53			214		
									5	219		BREAK
08	09	2640	76	S-2	106	.5	53			272		
									30	302		LUNCH
10	11	2640	68	S-2	106	.5	53			355		
									5	360		BREAK
12	13	2640	78	S-2	106	.5	53			413		
14		1320	36	S-2	106	.25	26			439		
								25		464		TO LANDFILL
									5	469		UNLOAD
								9		478		TO GARAGE
									32	510		GO HOME (INCENTIVE TIME)
TOTALS		18480	476	▨	▨	3.5	369	59	87	510		CUMULATIVE INCENTIVE TIME THIS CREW 32 MINUTES

FIGURE 3-4

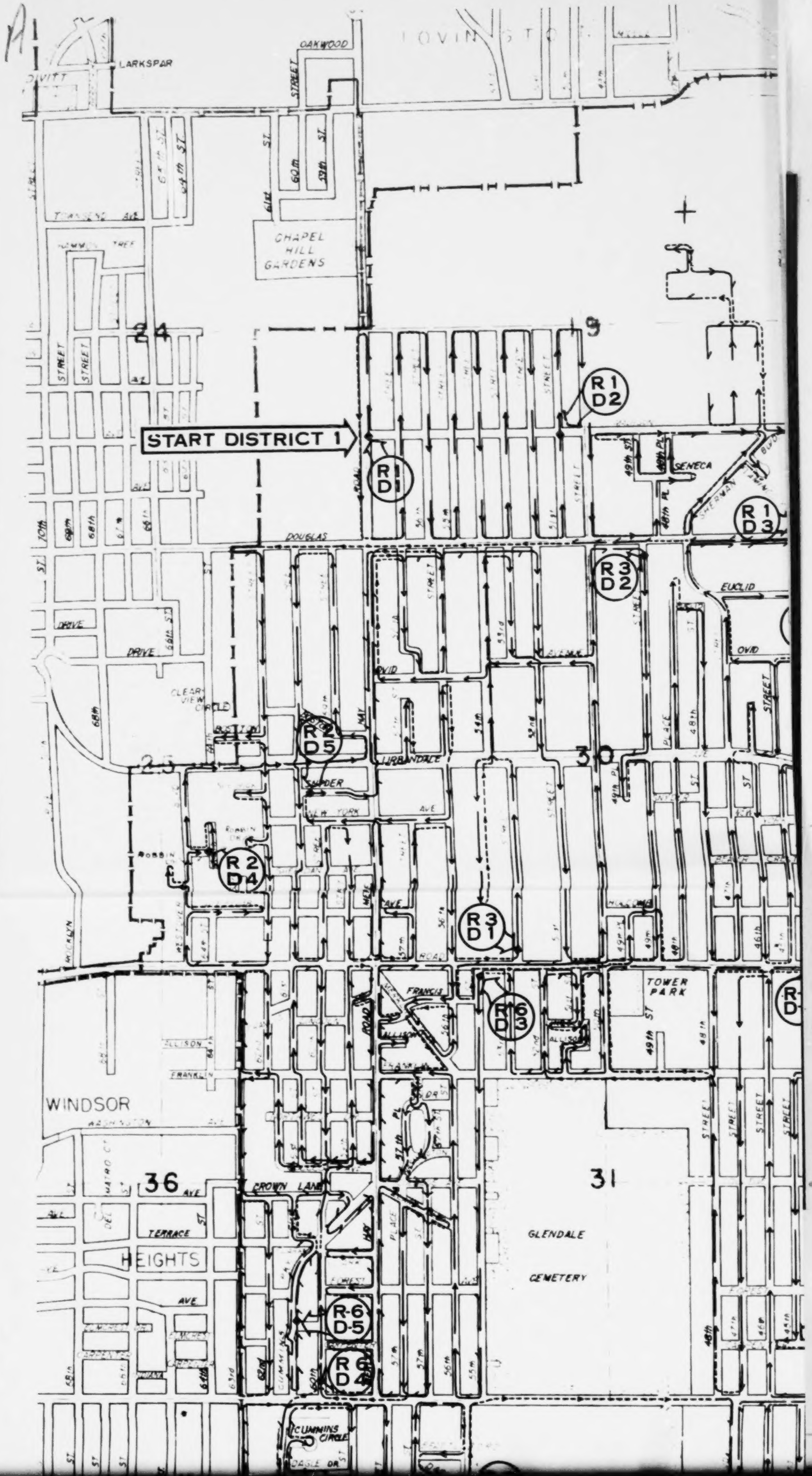
DISTRICT ____ DATE ENTERED ______ PAGE 1 REVISION ___

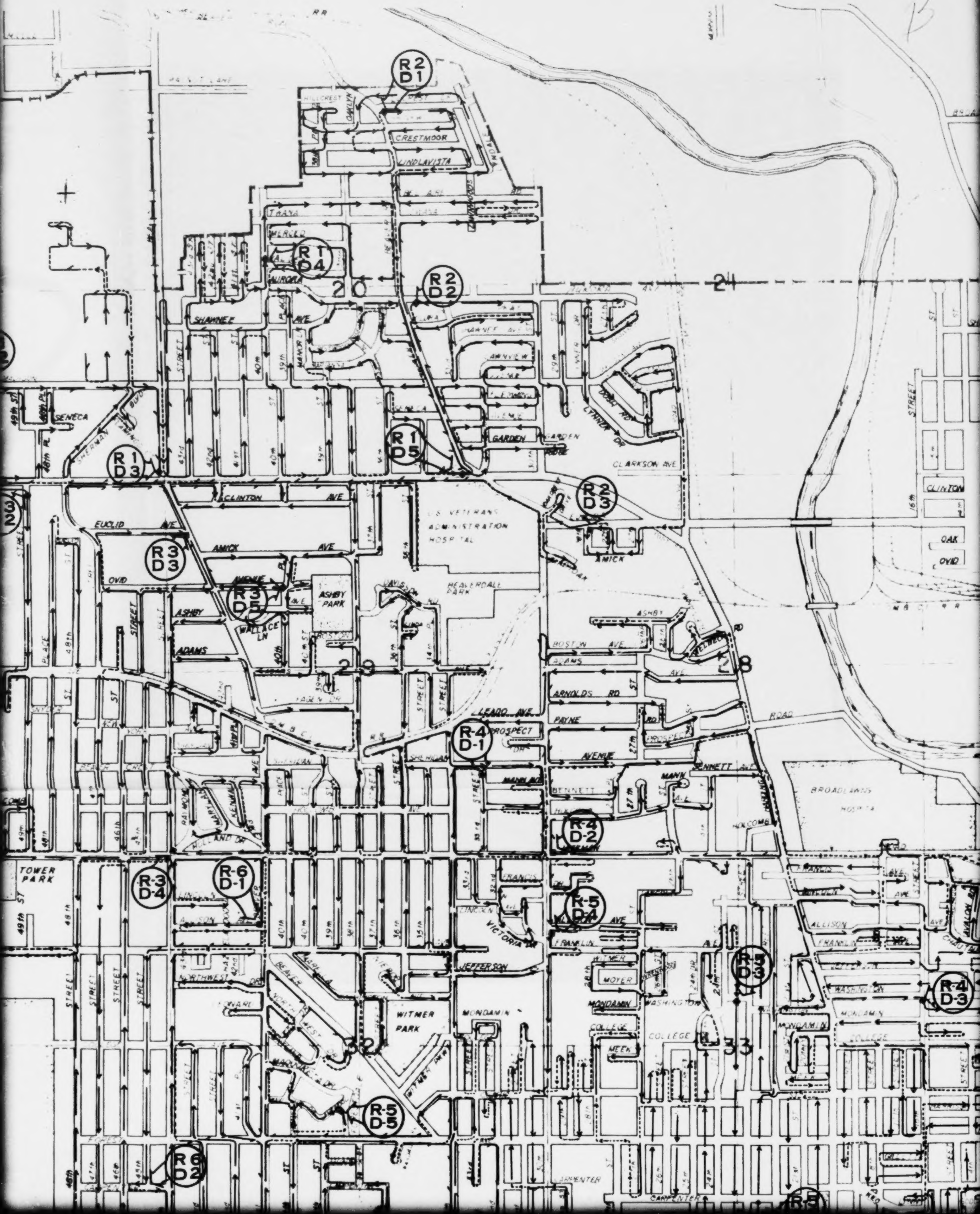
BLOCK	ON	HEAD	FROM *	TO *	SIDES **	TURN **	COLLECTION DISTANCE (FEET)	DEADHEAD DISTANCE (FEET)	DWELLING UNITS	REMARKS
01	Merle Hay	N	Madison	Aurora	R	TA	1320			
	"	S	Aurora	Madison	-	-		1320		
	"	S	Madison	Douglas	-	L		1320		
	Douglas	E	Merle Hay	57th	-	L		430		
02	57	N	Douglas	Madison	B	-	1320			
03	57	N	Madison	Aurora	B	R	1320			
	Aurora	E	57	56	-	R		330		
04	56	S	Aurora	Madison	B	-	1320			
05	56	S	Madison	Douglas	B	L	1320			
	Douglas	E	56	55	-	L		330		
06	55	N	Douglas	Madison	B	-	1320			
07	55	N	Madison	Aurora	B	R	1320			
	Aurora	E	55	54	-	R		330		
08	54	S	Aurora	Madison	B	-	1320			
09	54	S	Madison	Douglas	B	L	1320			
	Douglas	E	54	53	-	L		330		
10	53	N	Douglas	Madison	B	-	1320			
11	53	N	Madison	Aurora	B	R	1320			
	Aurora	E	53	52	-	R		330		
12	52	S	Aurora	Madison	B	-	1320			
13	52	S	Madison	Douglas	B	L	1320			
	Douglas	E	52	51	-	L		330		
14	51	N	Douglas	Madison	B	-	1320			
15	51	N	Madison	Aurora	B	TA	1320			
	51	S	Aurora	Madison	-	L		1320		
	Madison	E	51	50	-	L		330		
	50	N	Madison	1/3 Blk. N. of Madison	-	TA		400		
16	50	S	1/3 Blk. N. of Madison	Madison	B	-	660			
17	50	S	Madison	Douglas	B	L	1320			
	Douglas	E	50	48 PL	-	L		820		

SAMPLE PAGE
FROM
ROUTE BOOK

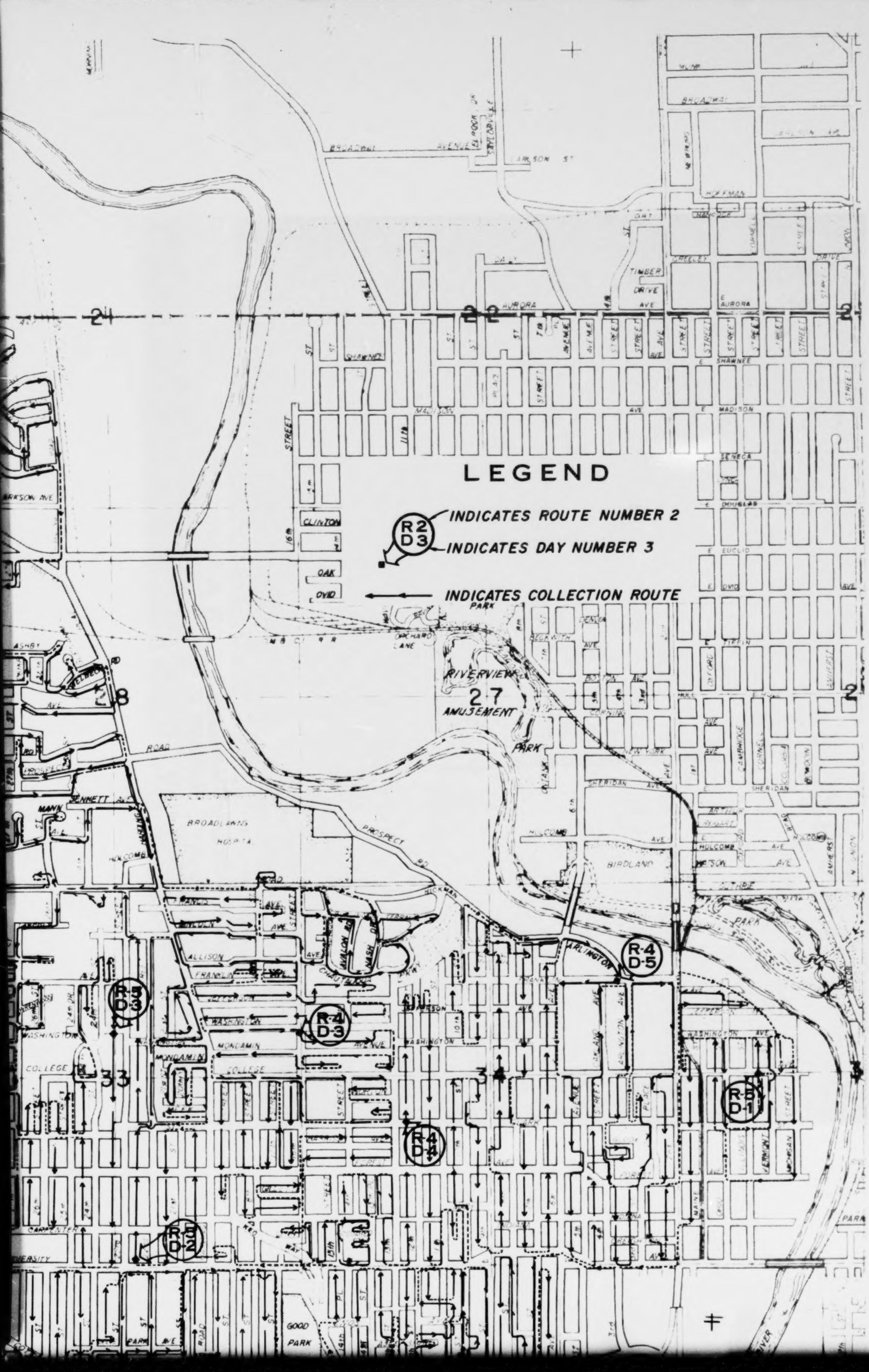
* ⓐ = ALLEY ** R = RIGHT, L = LEFT, B = BOTH, TA = TURN AROUND, BO = BACK OUT

FIGURE 3-3


A
LARKSPAR
DIVITT
OAKWOOD
LOVINGSTON
STREET
TOWNSEND AVE
CHAPEL HILL GARDENS
24
9
R1 D2
START DISTRICT 1
R1 D1
SENECA
49th ST
48th PL
SHERMAN
R1 D3
DOUGLAS
R3 D2
EUCLID
OVID
DRIVE
CLEAR VIEW CIRCLE
R2 D5
URBANDALE
25
30
SNYDER
NEW YORK
AVE
ROBBIN
R2 D4
R3 D1
ROAD
TOWER PARK
FRANCIS
R6 D3
ALLISON
FRANKLIN
WINDSOR
WASHINGTON
36
CROWN LANE
TERRACE
HEIGHTS
31
GLENDALE CEMETERY
R-6 D-5
R6 D4
CUMMINS CIRCLE
DAGLE DR


B
R2 D1
HILLCREST
OAKLYN
CRESTMOOR
LINDLAVISTA
BEL AIRE
THANA
MERCED
R1 D4
AURORA
20
R2 D2
AURORA AVE
24
SHAWNEE AVE
LAWNVIEW
SENECA
GARDEN
GARDEN RIDGE
LYNNER DR
CLARKSON AVE
R1 D5
R1 D3
SHERMAN
48th PL
49th ST
R2 D3
CLINTON AVE
EUCLID AVE
U.S. VETERANS ADMINISTRATION HOSPITAL
AMICK AVE
AMICK
R3 D3
OVID
AVENUE
ASHBY PARK
BEAVERDALE PARK
DAVISON
R3 D5
ASHBY
WALLACE LN
ADAMS
BOSTON AVE
ASHBY
ADAMS
ARNOLDS RD
29
28
FAGEN DR
LEADO AVE
PAYNE
PROSPECT
R-4 D-1
ROAD
SHERIDAN
AVENUE
BENNETT AVE
MANN
BENNETT
BROADLAWNS HOSPITAL
HOLCOMB
R-4 D-2
HOLLAND DR
TOWER PARK
R-3 D-4
R-6 D-1
FRANCIS
LINCOLN
R-5 D-4
VICTORIA DR
FRANKLIN
ALLISON
R-5 D-3
R-4 D-3
JEFFERSON
NORTHWEST DR
WITMER
MOYER
MONDAMIN
WASHINGTON
COLLEGE
HOWARD
BEAVER
WITMER PARK
32
33
MEEK
R-5 D-5
FOREST
R6 D2
CARPENTER
R-5
CLINTON
OAK
OVID
STREET
48th
49th
STREET

c


LEGEND
R2 D3
INDICATES ROUTE NUMBER 2
INDICATES DAY NUMBER 3
INDICATES COLLECTION ROUTE
21
22
27
28
33
34
RIVERVIEW AMUSEMENT PARK
BROADLAWNS HOSPITAL
BIRDLAND
PARK
GOOD PARK
R-4 D-5
R-5 D-3
R-4 D-3
R-4 D-4
R-5 D-1
R-5 D-2
BROADWAY
AURORA AVE
SHAWNEE
MADISON AVE
SENECA
DOUGLAS
EUCLID
OVID
CLINTON
OAK
TIFFIN
BECKWITH
NEW YORK
SHERIDAN AVE
HOLCOMB
HICKMAN
PROSPECT RD
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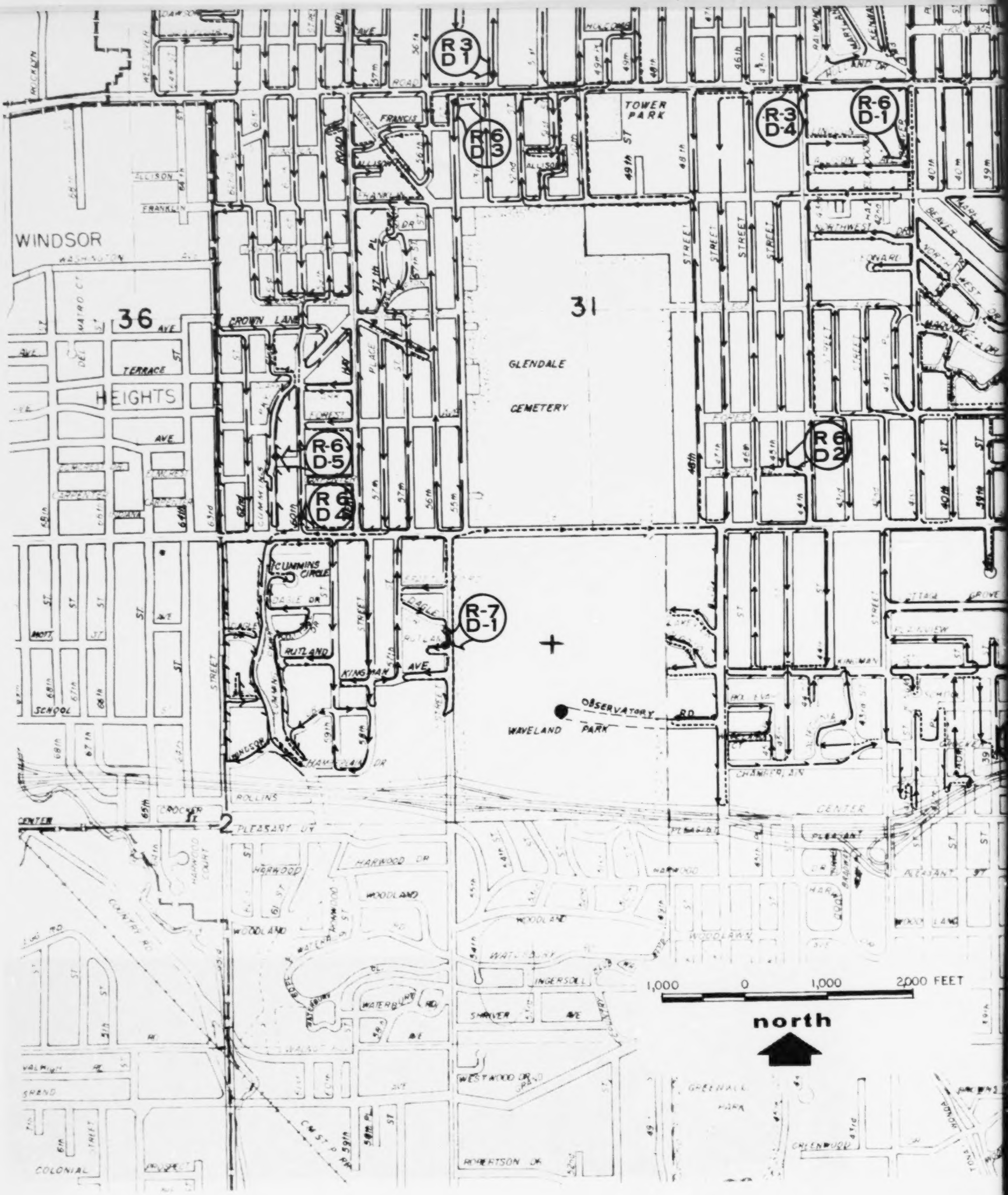
UNIVERSITY
ALLISON
ORCHARD LANE
RIVER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R-6 D-3
R-3 D-4
R-6 D-1
TOWER PARK
WINDSOR
HEIGHTS
36
31
GLENDALE
CEMETERY
CROWN LANE
R-6 D-5
R-6 D-4
R-6 D2
CUMMINS CIRCLE
RUTLAND
KINGMAN AVE
R-7 D-1
OBSERVATORY RD
WAVELAND PARK
CHAMBERLAIN
ROLLINS
CENTER
2
PLEASANT
HARWOOD DR
WOODLAND
WATERBURY
INGERSOLL
SHRIVER AVE
WESTWOOD DR
GREENWOOD PARK
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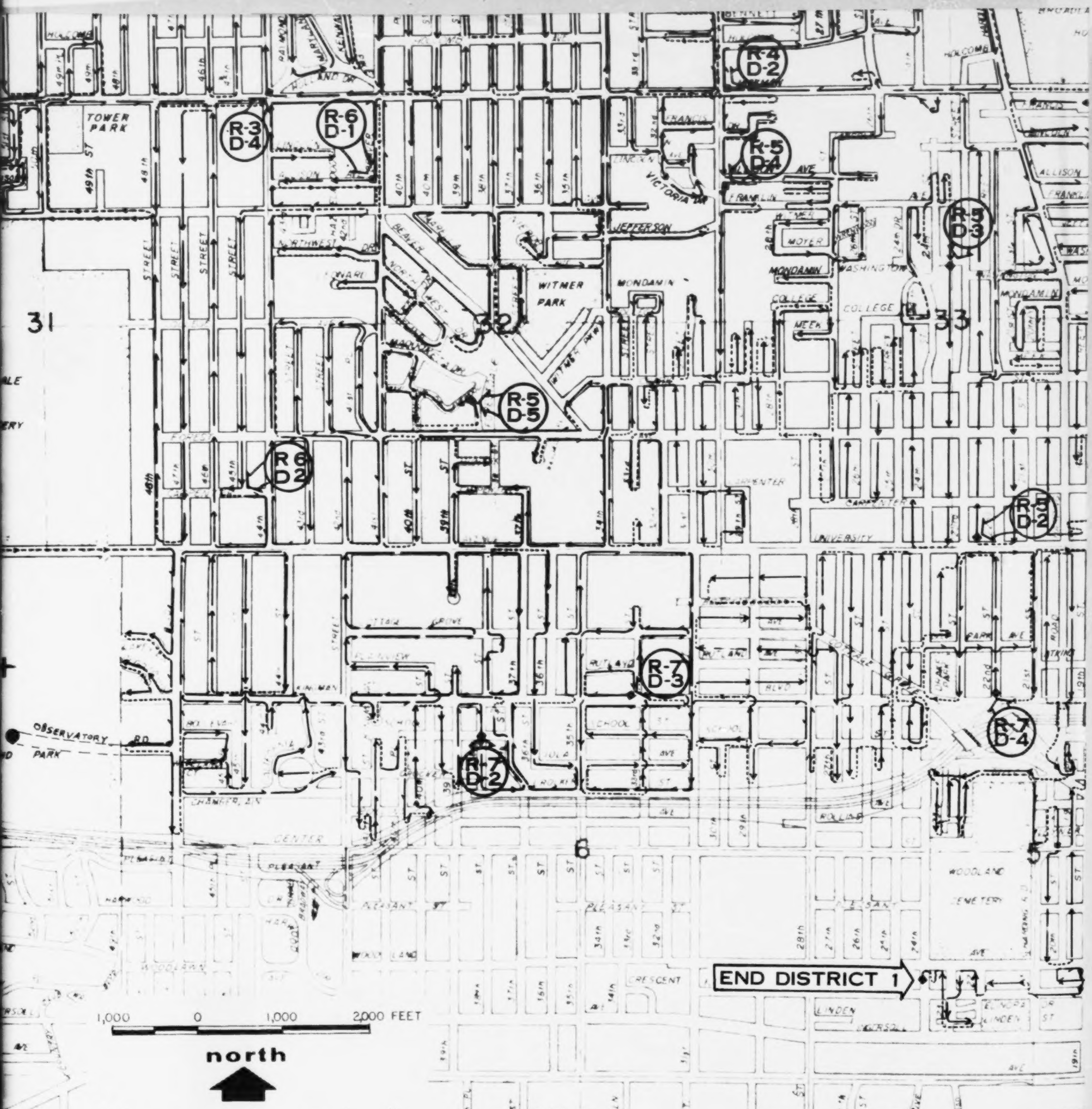
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D-4
TOWER PARK
WITMER PARK
WOODLAND CEMETERY
OBSERVATORY RD
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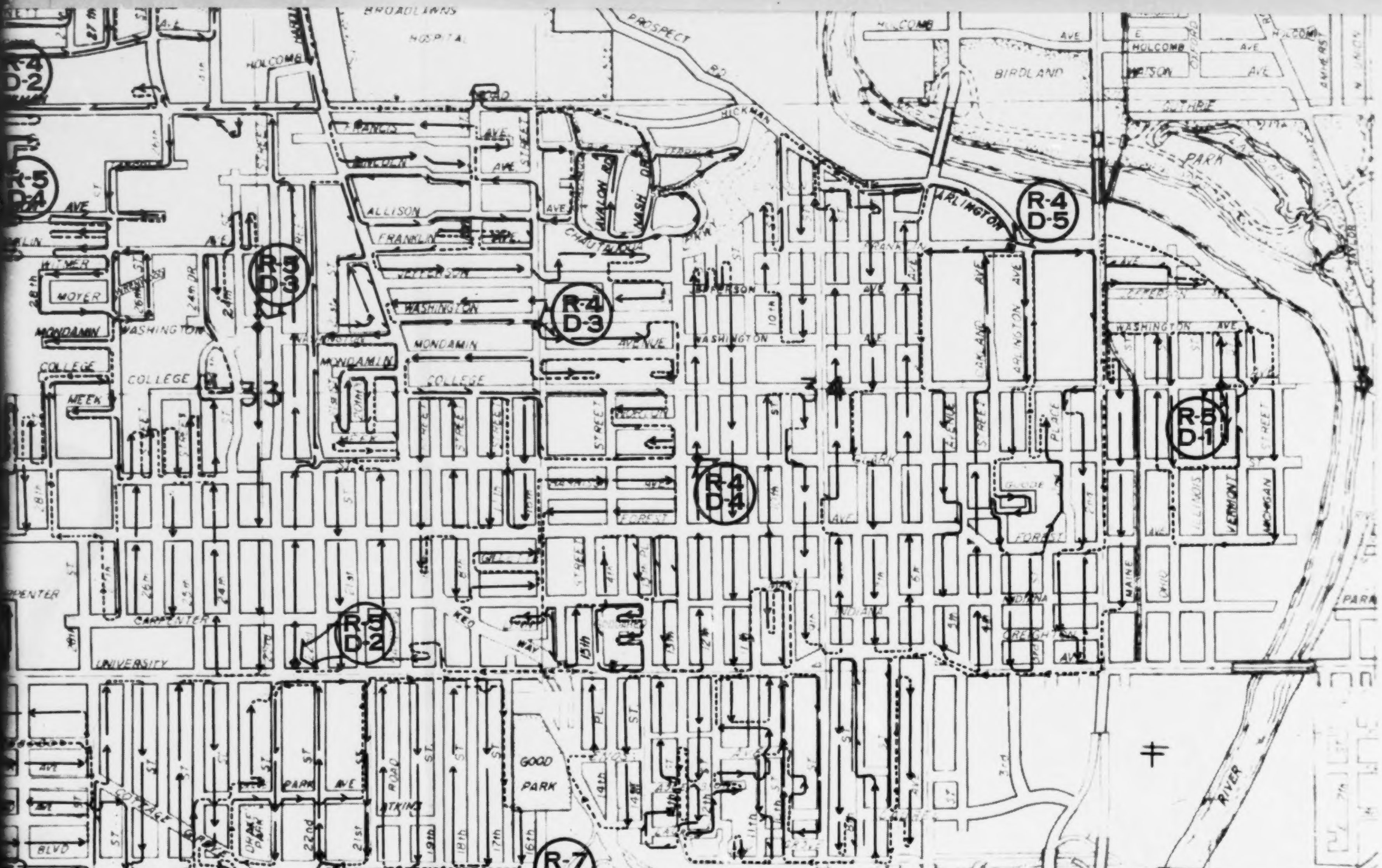
FRANCIS
LINCOLN
VICTORIA DR
FRANKLIN
JEFFERSON
WASHINGTON
MONDAMIN
COLLEGE
MEEK
ALLISON
NORTHWEST DR
FOREST
CARPENTER
UNIVERSITY
OTTAWA
GROVE
PLAINVIEW
RUTLAND
SCHOOL
IOLA
CHAMBERLAIN
CENTER
PLEASANT
ROLLINS
WOODLAND
CRESCENT
LINDEN
INGERSOLL
RIDGE
FOREST
BOLTON DR
GREENWOOD
STREET
AVE

E



R-4 D-2
R-5 D-4
R-5 D-3
R-4 D-3
R-4 D-5
R-5 D-1
R-4 D-4
R-5 D-2
R-7 D-5
R-7 D-4
33
3
4
5
BROADLAWNS HOSPITAL
HOLCOMB
PROSPECT RD
HICKMAN
BIRDLAND
GUTHRIE
PARK
ARLINGTON
FRANCIS
LINCOLN
ALLISON
FRANKLIN
JEFFERSON
WASHINGTON
MONDAMIN
COLLEGE
CHAUTAUQUA
AVALON
CARPENTER
UNIVERSITY
GOOD PARK
FOREST
OAKLAND
INDIANA
MAINE
ILLINOIS
VERMONT
MICHIGAN
KEO WAY
PARK AVE
ATKINS
COTTAGE GROVE
ROLLINS
WOODLAND CEMETERY
PLEASANT
CENTER
CROCKER
CALLANAN
KEOSAUQUA
DES MOINES RIVER
MAPLE
ND DISTRICT 1
LINDEN
INGERSOLL
ELINOPA DR
GRAND
RIDGE
FOREST
GILMORE
PARK PL
RIVER

DISTRICT 1
WASTE COLLECTION
ROUTE MAP

FIGURE 3-2

F

TABLE 3-3

DISTRICT I : RECOMMENDED ROUTES

ROUTE NO.	DAY	FROM BLOCK	TO BLOCK	COLLECTION MILES	COLLECTION MINUTES	CREW MEN	MAN MINUTES	HAUL MINUTES	DELAY MINUTES	INCENTIVE MINUTES
1	1	01	14	3.50	364	2	728	59	87	32
	2	15	38	3.64	358	2	716	59	93	38
	3	39	68	3.42	341	2	682	59	110	55
	4	69	98	3.45	358	2	716	59	93	33
	5	99	131	3.42	342	2	684	59	109	49
	ST.			17.43	1763	2	3526	295	492	Avg 41
2	1	132	161	3.42	350	2	700	59	101	41
	2	162	196	3.39	352	2	704	59	49	39
	3	197	232	3.69	352	2	704	59	99	39
	4	233	259	3.50	354	2	708	59	97	37
	5	260	279	3.70	354	2	708	59	97	37
	ST.			17.71	1762	2	3524	295	493	Avg 39
3	1	280	304	4.73	300	3	900	101	109	54
	2	305	336	5.25	327	3	981	101	82	27
	3	337	378	5.30	317	3	951	97	96	41
	4	379	424	5.26	317	3	951	97	96	41
	5	425	473	5.19	318	3	954	97	95	40
	ST.			25.73	1579	3	4737	493	478	Avg 43
4	1	474	526	5.36	322	3	976	97	91	38
	2	527	577	5.71	349	3	1047	89	92	37
	3	578	628	5.57	327	3	981	85	98	43
	4	629	693	5.72	345	3	1035	73	92	37
	5	694	737	3.90	237	3	711	73	100	45
	ST.			26.26	1579	3	4737	417	473	Avg 39
5	1	738	807	5.64	335	3	1005	79	96	41
	2	808	869	5.84	335	3	1005	85	90	35
	3	870	919	5.39	429	3	1287	87	99	44
	4	920	972	5.89	326	3	978	89	93	38
	5	973	1011	5.49	322	3	966	89	99	44
	ST.			28.25	1747	3	5441	429	477	40
6	1	1012	1046	5.52	322	3	966	93	95	40
	2	1047	1084	5.35	319	3	957	93	98	43
	3	1085	1131	5.62	326	3	978	93	91	36
	4	1132	1180	5.42	316	3	948	93	101	46
	5	1181	1234	5.67	320	3	960	93	97	42
	ST.			27.58	1603	3	4809	465	482	Avg 41
7	1	1235	1292	5.90	326	3	978	87	97	42
	2	1293	1344	6.09	336	3	1008	81	93	38
	3	1345	1403	5.65	332	3	996	81	97	42
	4	1404	1440	5.36	333	3	999	81	96	41
	5	1441	1490	5.46	335	3	1005	81	94	39
	ST.			28.46	1662	3	4986	411	477	Avg 40
TOTAL				171.42	11,695	95	31,760	2805	3372	1415
AVERAGE PER DAY				4.89	334		907	80	96	40

COLLECTION MINUTES PER DAY:

2-MAN CREW	352.5
3-MAN CREW	326.8
AVERAGE	334

COLLECTION MINUTES PER MILE:

2-MAN CREW	100
3-MAN CREW	60
AVERAGE	68

If a route is delayed and other crews within the District are assigned to assist the delayed crew, it is a simple matter to tell a crew to collect from Blocks #_____ to ______. By reference to their route book they will know exactly how to drive the blocks and the foreman will know how long it will take.

Supervisory personnel have been shown how the routes are designed and how to prepare similar routes for the rest of the City. They have also been provided with the necessary forms and sample calculations.

8. New Crew Requirements

a. Collecting Kitchen Waste Only. Based on the recommended new routes described previously, 95 man days per week are required to collect the residential solid waste in District I. The crew requirements are as follows:

Routes	Men Per Crew	Men	Man Days Per Week
1 & 2	2	4	20
3 through 7	3	15	75
Total		19	95

The present effort under existing conditions required to collect from District I is 139.5 man days per week as shown in Table 3-4.

Table 3-4

Present Collection System, Time Spent Collecting In District I

Route No.	Days in District I Area	Route No.	Days in District I Area
1	4.5	9	1.0
2	4.0	10	4.0
3	1.5	11	3.0
5	2.0	12	5.0
6	5.0	13	4.5
7	4.0	27	3.5
8	4.5		

Total Crew Days per Week	46.5
Men per Crew	x 3
Man Days per Week	139.5

The new required manpower will be 68% (95 ÷ 139.5) of the existing forces working in the area. The new requirement for trucks in District I will be 75% (35 ÷ 46.5) of the existing trucks used in the area.

To extend these requirements to include the entire City, it is necessary to eliminate the 2-man crew influence. Add 2 men making 7 crews of 3 men each for 21 men. The part of the City represented by District I requires 46.5 crew days out of a total of 135 (27 x 5), or 34.4%. New crew requirements for the entire City collected kitchen waste is 61.2 men (21 ÷ .344) less 2, which is equal to 59.2 men.

b. Collecting All Residential Waste. When collecting all residential waste instead of kitchen waste only, more time will be required per dwelling unit (DU).

Assume 330 min. per day collection, 2 1/2 men actually collecting (1/2 man driving) and 650 DUs per day. Also assume one extra container per DU and 8 seconds per extra container.

$$\frac{330 \times 2.5 \times 60}{650} = 76 \text{ seconds per DU (kitchen waste)}$$

Dwellings served at 84 seconds each = $\frac{76}{84} \times 650$ = 590 DU per day, when collecting all residential waste.

The crew requirements will increase by the ratio of 84 to 76 or 1.11. The manpower required to collect District I and to collect the entire City is as follows:

District I All Residential waste - 19 x 1.11 = 21 men

Entire City All Residential waste - 59.2 x 1.11 = 66 men

9. Procedure for Converting to New Routes. New routes in District I will cover all of the area now served by eight routes and parts of five others. The eight existing routes completely eliminated will free 24 men. The routes partially covered by District I will free additional men. From this number, 19 men should be selected for the crews of the new routes. The new crews should be given their route books and maps and an explanation of how they are used. They should be given time to become familiar with the area and allowed to drive each day's work. This can be accomplished well before the change-over is made. There will be parts of the new area that will need an intermediate pick-up by the extra crews, due to changes in scheduled dates of collection, if refuse accumulation and complaints are to be held to a minimum. Complaints for skips can be promptly remedied by the extra crews.

After the second, or third week, the crews should be able to carry the route without help from extra crews, except for remedial complaint calls, even if they use their incentive time and possibly run into overtime. Six or eight weeks may be required before crews can carry their routes in the minimum time, thus realizing the maximum incentive time.

Crews should be required to perform their routes as shown in the route book, without modification, until well into the six or eight week familiarization period. However, the foreman should allow the crews to move their starting and stopping points within their week's work, to even out any major imbalance in the individual day's work within the week. No change in the path of the route, or exchange of territory between crews should be permitted except where absolutely necessary.

At the end of six or eight weeks, the route should be adjusted as necessary, based on whatever information is available and what appears reasonable from the performance of the crews within a District. This can be done simply by changing the start-stop points of the various days. This adjustment cannot be based on any new standards, because no reliable new information will be available, except what the crews report when they finish their work for the day. At best, this first adjustment will even out a few imbalances. After the first adjustment, a technician should follow each crew on each day's work, recording the same information which was recorded by the technician during this study. The foreman must oversee the crews work and compare the technicians records with the crews assigned route, to be absolutely certain that the crews are following their routes and the work rules relative to rest breaks, lunch periods and hauling procedures, exactly as assigned. Since each day in each route will have been observed, it will be a simple matter to make adjustments in the routes by moving the start-stop points which define the route. This adjustment will be considered the final adjustment, at least for a considerable period of time.

Since the standards were set purposely easy, this adjustment should result in the elimination of a few route days at the end of the District. It is possible that all or most of the last route will be absorbed into the earlier route.

The data obtained from the technicians following the crews, and the factors concerning time, distance, and quantities computed from this data, can be used to establish routes in District II and III. The first balance should be closer than for District I because of the data taken from well organized routes and experience gained in the first District established. The procedure followed in establishing and adjusting District I should be repeated for Districts II and III.

10. Gathering New Data. As soon as the new routes have been adjusted as described in the preceding paragraph, new data gathering should begin. Each load collected in District I should be weighed each day. These weights and the other data required for the Drivers Daily Report should be recorded. From weighing of full trucks a pounds per cubic yard average can be computed. With such a unit weight, the cubic yards on partial loads can be calculated with reasonable accuracy.

Thirty working days after the "Final" adjustment of District I, several days of the last route in District I should be converted to collecting all domestic solid waste, in lieu of only kitchen waste. The end of the District is chosen for this conversion because these routes can be adjusted as required without readjusting the preceding routes. Similarly, the last few days of Districts II and III should be converted after they have been established on kitchen waste only. Records obtained showing increased quantities and time required for collection, will be necessary information when all routes are converted to collecting all domestic waste.

As part of the grant requirements under which this study was made, it was agreed that when the routes were reorganized to the extent that good data could be collected concerning all domestic waste such data would be gathered, analyzed and made available to the granting agency. The City will make the weighing and record the basic data. The consultant will assist in analyzing this data and will comment on any application concerning conclusions drawn in this report.

11. Equipment

a. Number of Trucks Required. Based on the requirements previously determined, the following truck requirements have been established:

Service	District I	Entire City
Kitchen Waste	7	20
All Residential Waste	7.75	22

Since there are now 27 active trucks and 3 standby spares, there will be a surplus of vehicles as soon as all of the routes have been reorganized, and no additional trucks will be required.

b. Size of Trucks Required. The calculations concerning the trucks required and the optimum size of packer body, are based on the data gathered when observing the collection crews. New data will be available as the new routes are established and adjusted. The following calculations and discussion based on the existing data should be repeated when the new data is available.

From City-wide averages, the crews collected 32.2 lbs. per minute when collecting kitchen waste. Using an average of 330 minutes for collection for the new standards, the average crew will collect 10,600 lbs. per day.

This will exceed the normal capacity of a 16 C.Y. packer truck which is 9,600 lbs. and require two trips to the landfill site. If one trip were made and the extra time due to the eliminated second trip was spent in collection, an additional 36 minutes would add 1,160 lbs. for a total of 11,760 lbs. per day. This approaches the limit of a 20 C. Y. packer body of 12,000 lbs., and on heavy days would exceed it. Two trips would be required.

When collecting all residential waste in lieu of just kitchen waste the amount collected from each dwelling unit will be 40% greater but fewer units will be collected. The average crew will collect 13,500 lbs. per day ($10,600 \times \frac{590}{650} \times 1.4$). This amount will normally exceed the single load capacity of 16, 20 and 22 C. Y. packer bodies, the latter being 13,400 lbs. On heavy days the capacity of a 24 C. Y. packer at 14,400 lbs. can be exceeded. Two trips will be required.

Two loads of a 16 C. Y. packer can haul 19,200 lbs. It appears that there is no reason to purchase larger equipment than the present 16 C. Y. fleet if the policy of collecting only kitchen waste is changed to collecting all domestic waste, as recommended in this report.

Those responsible for sizing the equipment must take into account the weight limitations for single axle truck chassis. A packer body 20 C. Y. or larger will probably require a tandem axle chassis. The packer body size and the point where tandem axles are required will depend on the weight of the material as determined by the new data gathering program.

c. Condition of Present Fleet. The present fleet is modern and adequately maintained except for appearance. The appearance of the trucks and packer bodies does not reflect the standards which should be set for a fleet of sanitation vehicles. These vehicles are advertising the department. They should be regularly cleaned inside and out and touched up with paint at those points receiving wear and tear.

It is suggested that when new vehicles are purchased, consideration be given to diesel engines and automatic transmissions. Careful cost records and performance measurements may prove these to be worthwhile. There is much discussion in the industry concerning these two items. Testing in the Des Moines area could be beneficial to future costs.

d. Labor Saving Devices and Procedures. The collection division currently uses aluminum tubs to carry waste from the customers' containers to the vehicle. These tubs are too small and obsolete, as explained in an interim report to the Public Works Department. We recommended larger plastic tote cans which are currently used throughout the country. The merit in these cans is in their large capacity. They should not be used to carry more material but instead are easier and quicker to load with a given amount of material. Presently the collector must stack bags of garbage, sometimes higher than the sides of these low tubs. There is great chance of spilling the stacked tubs, particulary when hoisting to the shoulder. The customers' containers can simply be dumped into the large cans without the time consuming stacking and spillage.

The cost of these large cans is negligible. The important cost to the department is labor. A can which costs $15.00 is unimportant when compared to the cost of a truck and crew which cost approximately $12.00 per hour, 2,080 hours per year.

It has been shown previously that the difference in cost to collect all residential waste, as compared to kitchen waste, is only the extra 8 seconds per customer it takes to empty one additional container. The improvement in any small item which will save labor regardless of the amount of saving is worthwhile when considering the many times this saving can multiply. For an indication of the potential saving if a more efficient tote can is used, consider the fact that approximately 4 million customer cans are handled each year.

It is also recommended that keys to the trucks be either issued to the drivers or given out and collected at the garbage headquarters where the men check in and out each day. The present procedure calls for the men to proceed from check-in at 0700, to the garage dispatcher cage, where they are issued keys. This procedure consumes valuable and unnecessary time. A 5 minute delay costs approximately 97 cents per crew, which is $26.00 per day or $6,800 per year. This particular delay can be eliminated for the price of keys which cost 35¢ each.

In the morning, on cold days, the crews have experienced difficulty in starting their trucks. This is common to fleets which are parked outside. The problem is not the storing of vehicles outside, but the delay to the crews. A garage man should be assigned the duty of starting all trucks on cold mornings in advance of the scheduled start of collection. One garage man can properly warm up all trucks and do what is necessary to start difficult ones at a fraction of the cost to the department when compared to a 3-man crew for each truck being delayed.

The truck is the second largest expense in the collection of waste, but this expense is only 1/6 the cost of the crew which uses it. Anything which can be done to improve the efficiency of the men must be considered. This is a management function presently lacking in many municipal systems today.

12. Costs. The cost estimates in Table 3-5 are based on the 1967 budget for the collection of kitchen waste only, and the collection of all residential domestic waste. The costs of existing personnel are taken from the 1967 revised budget. The personnel costs for estimated conditions are based on prices established in the 1967 budget, plus an 8.3% increase for holidays, vacation and sick leave, plus a 5% allowance for standby personnel. The estimated personnel requirements are based on liberal work standards established on a temporary basis. Therefore these estimates should be considered as conservative.

The estimates reflect the same costs that are included in the present budget. They do not include any overhead costs which are not now included in the Garbage Activity Budget such as office rent, Public Works administration, accounting and similar expense.

Table 3-5

Estimated Cost of Operation - Improved System

A. 1967 Budget (Existing) - Present Operations - Kitchen Waste Only

1.	Personnel:	
	Regular Employees	$502,203
	Temporary Employees	31,286
	Longevity	6,387
	Pension Contribution	39,514
	Workmen's Compensation	6,500
		$585,890 ÷ 98 = $5980/Yr/Man
2.	Equipment Rentals	$ 86,000 ÷ $3000 = 28.66 trucks
3.	Other	1,544
	Total Budget	$673,434

B. Kitchen Waste Only - Improved Operations

1.	Personnel:	Manpower	
	Basic Crew	59.2	
	Vacation, Sick Leave and Holidays @ 8.3%	4.9	
	Standby at 5%	3.0	
	Operating Crew Labor	67	
	Supervision	5	
	Total Personnel	72 @ $6000 =	$432,000
2.	Equipment:		
	Active Trucks 20 @ 3000	$60,000	
	Standby " 3 @ 1000	3,000	
	Automobiles 4 @ 1000	4,000	
	Total Equipment	$67,000	$ 67,000
3.	Other Expense	$ 2,000	$ 2,000
			$501,000

C. All Domestic Waste - Improved Operation

		Manpower	
1.	Personnel:		
	Basic Crew	66.0	
	8.3% Vacation, Sick Leave and Holidays	5.5	
	5% Standby	3.3	
	Operating Crew Labor	75.0	
	Supervision	5.0	
	Total Personnel	80.0 @$6,000=	$480,000
2.	Equipment		
	Active Trucks 22 @ 3000	$66,000	
	Standby " 3 @ 1000	3,000	
	Automobiles 4 @ 1000	4,000	
	Total Equipment	$73,000	$ 73,000
3.	Other Expense	$ 2,000	$ 2,000
			$555,000

The estimate to collect kitchen waste only, under the improved system as shown in Part B, Table 3-5, is $501,000. This is $172,000 less than the present cost of collecting the same kitchen waste only under existing conditions.

The estimate to collect all domestic waste under the improved system as shown in Part C, Table 3-5, is $555,000. This is $118,000 less than the present cost of collecting kitchen waste only under the present conditions.

F. Cost Comparisons. The several cost analyses developed in preceding sections are compared in Table 3-6. These costs are based on information received from the three cities. The data received was adjusted to reflect a common basis. Personnel costs include wages, payroll expense, vacation, sick leave, holidays and supervision. Truck costs are based on maintenance, repair, operating expenses and amortization. Office overhead, garage rental and interest on investment is not included.

Part A is a summary of the existing collection systems of Des Moines, West Des Moines and Urbandale. These cities collect only domestic kitchen waste on a once per week schedule and the cost shown is for this service.

Part B is an estimate of the cost of service if the cities were to increase their service to collect all domestic waste. These costs are based on present levels of efficiency but increased 16% to cover the increased service.

Part C is an estimate of weekly collection of kitchen wastes for Des Moines but with improved efficiency as recommended.

Part D is an estimate of the cost of weekly collection of all domestic solid waste assuming the improved efficiency. The estimate given for the Des Moines system is $118, 000 less than that now spent for the limited collection service now being furnished. Part D also indicates the estimated cost of weekly collection of all domestic solid waste if the population were increased to cover the population of the entire metropolitan area comprising the Study Area.

Table 3-6

Collection Cost Comparisons - Municipal Systems

	Total Cost	Population	Cost per Cap.	Cost per D. U.
A. Present Cost - Kitchen Waste Only				
DM	$673,000	208,000	$3.24	$ 9.72
WDM	51,500	14,000	3.68	12.88
URB	35,800	12,500	2.86	11.15
B. Present Cost Projected For All Domestic Waste				
DM	$783,000	208,000	$3.76	$11.25
WDM	59,700	14,000	4.26	14.90
URB	41,500	12,500	3.32	12.92
C. Est. Cost with Improved System - Kitchen Waste Only				
DM	$501,000	208,000	2.41	$ 7.24
D. Est. Cost Improved System - All Domestic Waste				
DM	$555,000	208,000	$2.67	$ 8.00
Metro Area	770,000	288,000	2.67	8.00

G. Future Collection System

1. General. The future organization recommended is a Metropolitan Solid Waste Agency. The details of this Agency, its purpose, formation, organization, financing and general operations are described in

Part Five of this report. In this section the collection activities of the Agency are described. It is assumed that all of the communities within the Study Area would be served by the Agency. In the event all do not join, the operations described here can be reduced as appropriate.

It is recommended that the Agency collect all domestic solid waste on a weekly schedule.

2. Organization. A superintendent shall be in direct charge of operation of the Collection Division. He shall receive policy, technical and overall direction from the Director of the Agency. The Study Area shall be divided into four districts each under the supervision of a district foreman who shall report to the Collection Superintendent. A records clerk shall maintain the records and prepare production records and reports and keep time for the collection service. Each district shall operate as a team, nominally independently of the other districts.

The incentive system and work rules as described in Part Three Section E 5 shall be followed. The trucks, other vehicles and equipment for the Colection Division shall be provided and maintained by the Equipment Section.

3. Operations. The operational headquarters will be located at the new Northeast Sanitary Landfill site, described in Part Four. Two of the districts shall work out of this site and two shall operate out of the Southwest site.

The Northeast site will have the main office, personnel facilities and main equipment maintenance and repair facilities. The Southwest site shall have personnel facilities for crews of the two districts operating out of this site and for the landfill personnel. In addition, preventative maintenance and minor repair facilities for the trucks and landfill equipment will be located at the site.

A description of the detailed operating procedures of the Collection Division would be beyond the scope of this report. It is necessary to staff the operation with competent people who know how to manage such an activity.

It is recommended that standard operating procedures be prepared which describe how to accomplish the major tasks and activities. Standard operating procedures should include the following subjects:

a. Personal injury accidents.

b. Property damage accidents.

c. Damage to collection equipment.

d. Preventative maintenance for equipment.

e. Daily inspection reporting of condition of truck chassis and packer bodies.

f. Fueling of equipment.

g. Cleaning of equipment.

h. Driving to, from and throughout the routes including brakes, lights, power takeoff, packer mechanisms and exact path to be driven.

i. Handling of customers refuse containers.

j. Lifting, carrying and storing tote containers.

k. Handling of complaints.

l. Tagging of improper containers.

In addition to the standard operating procedures, personnel rules, job descriptions, operating instructions and policies of the Agency should also be prepared.

Formal programs should be developed for the following items:

a. Health and safety.

b. Driver training.

c. Personnel selection, management and retention.

d. Investigation of mechanical breakdown of equipment.

e. Collection route efficiency and work load balance.

f. Selection and procurement of equipment and labor saving devices.

g. Cost control.

h. Gathering of basic data.

i. Public relations.

4. Routes. At the time of the creation of the Agency collection system the three districts in the Des Moines system should be functioning properly under the new procedures recommended. The Agency will use the routes in the

districts as a nucleus upon which to build a complete system. The procedures established for setting standards and routes should be followed in determining the additional routes necessary to serve the Study Area.

The routes should be regrouped into four districts with the boundaries of the districts determined by the areas that will be collected by the crews which will work out of the two sanitary landfill sites.

5. Equipment Considerations. The basic equipment to be used for collection will be trucks with packer bodies. It is contemplated that the existing equipment now owned by cities joining the Agency would be leased to the Agency for its use. The Agency would purchase new equipment to replace the leased equipment as it was amortized, beginning the first year. By leasing equipment the cities will have a method of orderly disposal of their equipment inventories. The three cities in the Study Area which operate their own systems now have adequate equipment to collect from the entire Study Area.

Replacement equipment should be sized to best fit the needs of the routes to which it will be assigned.

It is recommended that detailed cost and use records be accumulated on each vehicle and vehicles of like specification. With such records it is possible to make intelligent management decisions concerning the amortization periods and decisions concerning overhaul or replacement of individual units. The superintendents of the Collection Division and Equipment Section, together with the Assistant Director and Director should have the necessary skills and knowledge to make cost and performance analysis and completely understand and practice equipment management.

6. Personnel and Equipment Requirements. The estimates of personnel and equipment for the new Agency and the costs, both annual and initial, have been adjusted from the temporary standards set forth previously. There will be additional opportunities to readjust the estimates contained in this section as new performance data becomes available but it is necessary now to make some adjustments upon which planning can begin.

In Table 3-7, the population, basic crew size and basic truck requirements are set out for Des Moines in item 1a, based on the new temporary standards. They are also shown increased in item 1b, in direct proportion to a larger population. This population is equal to the estimated 1967 population of the metropolitan area included in this study. Item 1c shows the basic crew size and truck requirement after a 10% reduction in the initial temporary standards has been applied. The actual reduction should be greater than 10% and thus costs may be less than will be shown for these items; however for planning purposes a 10% factor is considered adequate.

Items 2 and 3 show the basic crew sizes and truck requirements developed into operational requirements.

Table 3-7

Personnel and Equipment Requirements
Collection of All Domestic Waste-Study Area

1. Projection from City of Des Moines as base unit:

		Population	Basic Crew	Basic Trucks
a.	Des Moines Temporary Standards	208,000	66	22
b.	Des Moines Temporary Standards	288,000	91,5	30.5
c.	Metropolitan Agency*	288,000	82.3	27.4

*Reduced 10%

2. Personnel Requirements:

a.	Basic Crew	82.3
b.	Vacation, Sick Leave and Holidays 8.3%	6.8
c.	Standby 5%	4.1
	Sub-Total	93.2
d.	Superintendent	1.0
e.	Foreman	4.0
f.	Clerk	1.0
	Total Personnel	99

3. Equipment Requirements:

a.	Active Trucks	28
b.	Standby Trucks	3
c.	Automobiles	5

7. Personnel. The total personnel of the Collection Division is shown in Table 3-7. The 98 men working under the direction of the Collection Superintendent represent a large personnel management challenge and the most important part of the operation. The men represent the largest cost item and are the heart of the operation. The difference between a successful and economical operation and something less will be the manner in which these men are motivated and supervised.

Modern personnel management techniques must be initiated for hiring, training and retention.

The screening of new personnel should include a complete physical examination, a drivers test and previous driving history investigation for both drivers and collectors. The driver is considered to be the crew chief and does the major driving; however, he also assists in the collection of waste while on route. The collectors do both collecting and minor driving while on route. Both must be in sound physical condition and capable of operating the truck.

The concept that anyone is suitable for refuse collection work is incorrect. A crew is a unit which operates alone most of the time. Their level of performance is important to the cost and overall success of the department. They also represent a major exposure of government to the public. They should be properly selected, trained and supervised as the most important element of the service. Their status and image should be protected and improved at every opportunity.

8. Collection Costs. Basic cost data and annual costs are presented in Table 3-8. It is contemplated that the large "initial" expenses estimated to be approximately $444,000 would be financed from the proceeds of bonds over a period of 20 years. The annual payment of bonds and the annual reoccurring expenses for collection would amount to a cost of approximately $820,100 per year. The disposal of the material collected by the department would cost $1.10 per ton which is the suggested charge made for all users of the disposal facilities. This cost would be $73,300 for the disposal of an estimated 66,600 tons per year. The total cost of this collection activity including disposing of the material collected is $893,400 per year.

Although not a cost of operation or debt service, bond buyers will insist on a reserve for the annual debt service. This varies but for estimating purposes we have assumed a 40% factor. The debt service reserve would be .4x the debt service of $34,100, or $13,600. The total revenue requirement for this collection service would be $907,000 per year.

Table 3-8

Cost Estimate for Collection of All Domestic Waste in Study Area

A.	Basic Cost Data				
	1.		Initial Purchase of Equipment (one time only)		
			28 Packer Trucks @ 9500	$266,000	
			5 Automobiles @ 3000	15,000	$281,000
	2.		Agency Headquarters and Repair Shop (one time only)		
			Office	$ 36,000	
			Repair Shop	50,000	
			Repair Equipment	60,000	
				$146,000	
			50% Each for Collection and Disposal		73,000
	3.		Truck Storage Garages 2 @ $45,000		90,000
	4.		Operating Personnel (annual)		
			99 men @ $6,000 per year		594,000
	5.		Operating Equipment (annual)		
			Active Trucks 28 @ 3,000	$ 84,000	
			Standby Trucks 3 @ 1,000	3,000	
			Automobiles 5 @ 1,000	5,000	
					92,000
	6.		Miscellaneous Expense, Overhead and Contingency		100,000
B.	Annual Costs				
	1.		Debt Service Requirement - 20 year Bonds @ 4 1/2% (0.0768)		
		a.	Initial Equipment Purchase	$281,000	
		b.	Agency Headquarters and Shops	73,000	
		c.	Truck Storage	90,000	
				$444,000	
				@ 0.0768	34,100
	2.		Reoccurring Annual Expense		
		a.	Operating Personnel	594,000	
		b.	Operating Equipment	92,000	
		c.	Miscellaneous Expense, Overhead and Contingency	100,000	
					786,000
			Total Annual Cost of Collection		820,100
C.	Disposal Fees for Material Collected, 66,600 Tons per year @ $1.10 per ton				73,300
D.	Total Annual Cost of Collection Service				$893,400
E.	Debt Service Reserve $34,100 x .40				13,600
F.	Total Required Funds For Collection				$907,000

9. Cost Comparison. A comparison is made in Table 3-9 between the estimated cost of Agency service, and the cost of various other collection services now being offered in the Study Area.

Part A shows the estimated cost of Agency collection of all residential waste. See Part Five section E for details.

Part B shows the cost of contract collection in the Town of Pleasant Hill. The contract provides a charge based on $1.50 per dwelling unit per month, for weekly kitchen waste service. This cost is approximately 1.7 times the estimated cost of Agency collection of all domestic waste.

Parts C and D show the cost of weekly service for kitchen waste and all domestic waste collection where the individual householders make arrangements with private haulers for private service. The prices in the community vary; however the cost of $2.00 per month and $2.50 per month respectively are typical. The price per dwelling unit for all domestic waste of $30.00 per year is 2.7 times the estimated cost of similar service under Part A.

Table 3-9

Collection Cost Comparison - Agency and Other Systems

A.	Cost of Agency Collection - All Domestic Waste.	$10.80 per dwelling unit per year.
B.	Cost of Contract Collection - Kitchen Waste. Pleasant Hill.	$18.00 per dwelling unit per year.
C.	Cost of Individual Private Hauler Collection - Kitchen Waste. Miscellaneous Customers	$24.00 per dwelling unit per year.
D.	Cost of Individual Private Hauler Collection - All Domestic Waste. Miscellaneous Customers	$30.00 per dwelling unit per year.

PART FOUR - DISPOSAL OF SOLID WASTE

A. General. The disposal of solid waste, as discussed in this Part of the report, is based on the regional approach similar to that presented in Part Three, concerning solid waste collection. One or two large disposal facilities, regardless of the type, can be operated at a unit cost which is considerably less than that resulting from many smaller facilities. In addition, a larger facility can attract and can afford the necessary full time professional management required to operate the disposal facility properly.

Solid waste disposal can be accomplished using any of several methods. The selection of the most appropriate method depends on the particular circumstances that prevail at the time and in the location where the disposal is needed.

The old town dump, where refuse was burned from time to time was acceptable when there were fewer people, less intense land development and little knowledge of air pollution. Today this practice is inappropriate.

In some sea coast communities combustible refuse is burned on barges far out to sea and the residue dumped into the water. This practice is now condemned as a source of air and water pollution.

In the large metropolitan regions such as the New York City area, land, labor and transportation costs present a different set of circumstances than prevail in the Study Area around Des Moines. Each community or region must consider methods which are based on local conditions.

In the following paragraphs, three basic types of disposal are discussed; Incineration, Composting and Landfilling.

B. Description of Disposal Methods

1. Incineration

a. Discussion. This process consists of reducing combustible refuse to an inert residue by burning, within an enclosure, under high temperatures and controlled conditions. When accomplished in a large facility for a community with waste transported to the facility from several sources it is referred to as Central Incineration. When accomplished by individuals or commercial, industrial or institutional concerns for their own locally generated waste it is referred to as On Site Incineration

Central and On Site Incinerators are used for two purposes; to reduce large volumes of waste to a small volume of residue and to change the form of a material which may be dangerous or a nuisance to one which is safe or nuisance free.

Municipal incineration plants are familiar to the general public. Unfortunately many poor examples are in existence today. They should not be considered as typical of what a modern plant can be. The modern plant with proper air pollution control devices, burning at high temperatures and equipped with proper controls and site facilities can be operated in any area zoned for industrial use without creating a nuisance.

There are many incinerators throughout the United States which are fine examples of industrial architecture. Much of the public would be unaware of the function of the facility if it were not for signs on the building or at the gates.

A major advantage of the central incinerator is the relatively small land requirement and the ability to locate the plant in an industrial area within a city. The central location reduces the hauling cost not only for the city collection crews, but also for the industrial and commercial users of the facility. This advantage is particularly important in large metropolitan areas where there is a high cost in hauling materials from the place where the waste is generated, to landfill sites in rural areas. It is not as important in this Study Area where rural land is available within a few minutes driving time from the center of the city.

The major disadvantage is the cost of initial construction and the cost of maintenance and operation. These costs amount to approximately $6.50 per ton as described in Table 4-3.

The central incineration plant receives only a portion of the solid waste of the community. Approximately 1/4 of the volume and 1/2 of the weight of the waste is incombustible and must be diverted to landfill sites. Also part of the waste which is incinerated will remain as residue which must be landfilled. Waste water from an incineration plant from air scrubbers and quenching must be treated.

Modern incinerators generate considerable amounts of waste heat. In some new plants heat is now being put to economical use as steam which is either used for generation of electricity or used directly as steam or hot water in a variety of processes. The steam or electricity thus produced is sold to offset part of the cost of operation. The first cost is higher but it is a worthwhile investment.

Formerly excess air was introduced into incinerators to reduce the temperature of the stack gasses. With increasing air pollution requirements the cost of scrubbing these excess air quantities is greatly increased. The recovery of excess heat in the form of steam not only produces a valuable product, but also reduces the required quantity of excess air which in turn reduces the cost of scrubbing the stack gasses.

To be economical, steam for electric generation should be high pressure and in large enough quantity to operate a large generator. Many small electric power generating plants are abandoning their small units as uneconomical to operate. This is due to the interconnection of power lines where very large generators can serve many areas more economically than the individual communities can serve themselves. There is not enough heat involved in this particular situation to consider electric generation. Steam or hot water could be sold if there was a buyer close by.

Some plants with waste heat recovery devices have claimed a cost reduction of approximately $2.00 per ton. If this was possible in the Study Area, the cost of incineration could be reduced from $6.50 per ton as shown in the cost estimate to $4.50 per ton.

The cost of a sanitary landfill discussed in the following paragraph is approximately $1.10 per ton. Thus incineration costs would be between 4 and 6 times as expensive. In addition, a sanitary landfill would be required for the materials which could not be incinerated and for incinerator residue.

Based on costs, a central incinerator plant is not recommended.

Certain industries, commercial establishments and institutions may wish to operate on site incinerators as a matter of convenience. If they are properly designed and operated they should be permitted. The design; however, must include all of the necessary controls and devices to insure proper burning and safety and air pollution controls.

Some on site incinerators may be necessary. For example, the safe disposal of infectious or otherwise contaminated materials from hospitals or drug manufacturers requires incineration. Also highly volatile and inflammable liquids from other industries cannot be safely buried in a landfill. In these cases, incineration is necessary and an acceptable method of disposal; however, they should be licensed and controlled.

b. Quantities of Material and Cost of Incineration. In computer programs A, B and C as described in Part Two, each load of materials which was measured at the six site surveys was tested by the computer to determine whether that load could be sent to a central incinerator or should be diverted to a sanitary landfill. Two quantities were determined; (1) the volume and weight of material which could be accepted and processed; and (2) the volume and weight of material which should be diverted to sanitary landfill.

These quantities were based on the materials as measured at the several sites during the surveys and therefore included the special tree wastes. It would not be appropriate to consider these special tree wastes when determining the quantities for incineration because these wastes will not occur in large quantities after 1972. These quantities also did not include the on site disposal.

To obtain reasonable estimates for incineration, the quantities from the computer programs were used to determine the percent disposable by incineration. This percentage was adjusted for special tree waste quantities and then applied to the total 1967 quantities which include measured quantities and estimated on site quantities.

Tree waste, including special tree waste and normal tree waste, consists of Material Classifications 10, 11, 12 and 13. Classifications 10 and 11 are logs and stumps which cannot be sent through an incinerator. Classifications 12 and 13 are limbs and leaves which can be incinerated. Classes 12 and 13 represent 58% of the volume and 35% of the weight of the total tree waste. The basis for these percentages are shown in Table 4-1.

The quantities of materials and cost estimates are shown in Tables 4-2 and 4-3.

Table 4-1

Special Tree Waste Percentage to Incineration

	Volume*		Weight *	
1967	CY/Wk.	CY/Yr.	Lbs/Wk.	Tons/Yr.
A. Materials not sent to Incineration				
1) Class 10 Matl., as measured	2,700		1,823,000	
2) Class 11 Matl., as measured	1,360		920,500	
3) Sub Total	4,100	211,000	2,744,000	71,000
B. Material Sent to Incineration				
1) Class 12 Matl., as measured	195		62,000	
2) Class 13 Matl., as measured	5,300		1,431,000	
3) Sub Total	5,500	286,000	1,493,000	39,000
Total (Class 10+11+12+13)	9,600	497,000	4,237,000	110,000
C. Percent of Matl. sent to Incineration	58%		35%	

*Adjusted for seasonal variation.

Table 4-2

Quantities of Materials for Incineration

1967 as Measured	Volume*		Weight*	
	Cy/Wk.	Cy/Yr.	Lbs/Wk.	Tons/Yr.
1) Total Wastes (a) (b)	39,000	2,026,000	17,720,000	461,000
2) Wastes to Incinerator (a)	30,000	1,577,000	9,363,000	243,000
3) Total Special Tree Wastes (b)		423,000		94,000
4) Incineration Potential (@58%)		246,000		
(@35%)				33,000
5) NEW Total Wastes (Line 1 less Line 3)		1,603,000		367,000
6) NEW Waste to Incinerator (Line 2 less Line 4)		1,331,000		210,000
7) NEW Waste to Sanitary Landfill		272,000		156,000
8) NEW Percent of Waste to Incinerator		83%		57%
9) 1967 Total Waste (c)		2,480,000 (b)		562,000
10) Less Total Special Tree Waste (c)		440,000 (b)		103,500
11) 1967 Total Less Special Tree Waste		2,040,000		458,500
12) Quantity to Incineration 1967				
83% x Line 11		1,690,000		
57% x Line 11				260,000
13) Quantity to Incinerate 20th Yr. 57% x 741,000 (c)				423,000
14) Quantity to Incinerate Avg. Yr.				
1987 accumulation 13,563,000 Tons				
- 1967 accumulation - 562,000				
- Special Tree Waste - 870,000				
20 yr. accumulation 12,131,000 Tons				
Avg. yr 12,131,000 ÷ 20 x .57				346,000

(a) From Computer Program A, Exhibit 2-15

(b) Compacted in place quantity adjusted to "as received".
2.45 "as received" = 1 C.Y. compacted

(c) From Table 2-10

*Adjusted for seasonal variation

Table 4-3

Cost Estimates for Incineration

1) Quantities

20th Year	423,000 Tons
Average Year	346,000 Tons

2) Daily Quantity Average, 20th Year, 1987
423,000 x 7/6 ÷ 365 = 1,350 tons/day average.

3) Capacity = 1.2 x 1,350 = 1,620 tons/day Rated Capacity

4) Cost Estimates

a. First Cost @ $7,500/ton x 1,630 = $ 12,225,000

b.	Amortized for 20 years @ 4.5% (.0768) =	$ 939.000
c.	M & O @ 3.48/ton for average year x 346,000 =	1,201.000
d.	Hauling residue to Landfill, 20% of avg./yr. x 346,000 = 69,200 tons @ $1.74 first ton -	120,000
	Total Cost of Incineration - for average year	$2,242,000

5) Cost per ton Incinerated

$2,260,000 ÷ 346,000 tons = $6.50 per ton

NOTES: First cost = $6,800 + 10% for Administration and Engineering = $7,500 per rated ton. Cost of $6,800 was selected arbitrarily from reported costs ranging from $4,900 to $9,100. Actual costs must be based on detailed designs. These estimates are adequate only for establishing the magnitude of the cost per ton of incineration capacity. The M & O cost are similarly approximate.

2. Composting. This process consists of the conversion of the organic portion of the solid waste through aerobic digestion, to a stable and harmless material, which may be used for a soil conditioner or as fertilizer.

Micro-organisms which are present in garbage and other organic material will cause the waste to decompose. The composting plant provides the proper environment for these organisms. The plant receives only those loads of solid waste which can be composted. Loads not suitable for composting are diverted to sanitary landfills. The waste which is accepted is picked to remove non-compostable materials. Some of these materials have a value and are salvaged. After picking, the remaining material is pulverized and moisturized with various processing equipment. The material is then subjected to a composting period varying from one to two weeks during which the temperature, moisture and air content is carefully controlled, and the material is mixed. At the end of the composting period, the waste has been converted to compost which is a humus like material having some value as a soil conditioner or as a form of fertilizer.

Composting has been practiced for many years with little success. In recent years, several research and development projects have been undertaken which have improved the process. The modern plant of today is a highly mechanized facility utilizing quality equipment designed or specifically adapted for this process. Several well known national companies and equipment manufacturers have built and are operating composting plants in Texas, Arizona and Florida.

Unfortunately, some of these modern plants have had serious difficulty with odor problems. It is assumed that these problems can be overcome and within a few years it will be possible to process compost in a nuisance free manner.

The cost of composting is considerably greater than the cost of landfilling. One of the most recent plants constructed by a national company in cooperation with a major Florida City was placed into operation and received 100 tons of compostable refuse per day. The City pays a fee of approximately $3.25 per ton to the operator to take the material. This fee is approximately 3 times the cost of landfilling and in addition the non-compostable material must be landfilled.

Whether the compost material can be sold is a debatable question. Attempts to sell soil conditioners in large quantity in the Mid-West have not been successful.

It is possible that the composting process may be practical some years in the future. Today in the Study Area it is not recommended as a satisfactory method of solid waste disposal.

The quantities of material which could be composted are not included in this report. The basic data is available from the computer programs and the method of calculation is similar to that shown in the preceding paragraphs on incineration.

3. Landfilling. This section discusses sanitary landfills in general and two variations of the process: dry landfills and wet landfills.

Sanitary landfilling is a process in which solid waste materials are spread on the ground, crushed and compacted into a dense mass and covered with earth in a carefully controlled sanitary manner. This method is a proven system which when carefully planned and operated is economical and nuisance free.

The filling can be on land ranging from level land to gullies or ravines. In many instances, rough and low value land has been improved by filling.

The term sanitary landfill has frequently been confused with open dumps or burning grounds. This is incorrect. A sanitary landfill is a specific process requiring careful design and management, proper equipment and operating techniques to assure that sanitary conditions are maintained at all times. The compacted waste is completely covered with earth on a daily schedule. Each day's waste is therefore enclosed in an earth cell. These cells preclude rodents and insects, odors, litter, air and water pollution and fires. Emphasis is placed on proper location, equipment, compaction and cover, sight screening and other sanitary and aesthetic requirements.

The major disadvantage is that large quantities of land are required. In certain parts of the country this requirement can be disqualifying. However, in the Study Area, there is land available at locations close enough for economical hauling.

Another potential disadvantage is the frequent lack of public acceptance of sanitary landfilling. This is due to the bad reputation of dumps and the public confusion of dumps and sanitary landfills. A good public relation program and a demonstration of proper sanitary landfill operations can reduce the public resistance.

Sanitary landfilling is estimated to cost approximately $1.10 per ton as shown in Section K of this Part Four. When compared to the cost of incineration and composting this method is the least expensive.

Two variations on the sanitary landfill method were also considered: The dry and the wet landfill.

Certain materials such as broken concrete, demolition waste ashes, etc. can be used to fill gullies, worked out quarries or low land without requiring full sanitary landfill methods.

Filling a dry area with such material is referred to as dry landfilling. Filling areas which could be wet from ground water or surface overflow with suitable material is referred to as wet landfilling.

The materials which are considered suitable for these two methods are described in Part Two under computer programs. The quantities which can be placed in dry and wet landfills were determined in Computer Programs A, B and C.

These quantities do not appear to be large enough to warrant consideration as a disposal method for the Study Area. However, they do indicate the potential quantity of material which may be diverted from public sanitary landfill sites when fees are charged for disposal.

C. Recommended Method of Disposal. The sanitary landfill method is recommended for the following reasons:

1. Land is available.
2. The method has been proven satisfactory where properly operated.
3. The method can meet all health and sanitation requirements, and be aesthetically pleasing.
4. The method is adaptable to varying quantities and peak or slack rates.
5. The method is the most economical.

The sanitary landfill method is described in Section I of Part Four.

D. Existing Disposal Operations

1. General. The existing methods of disposal within the Study Area include; sanitary landfills, semi-sanitary landfills, open dumps and open burning dumps. In addition, there are many small private incineration facilities which are considered incidental to the disposal facilities of the community.

It is recommended that all of the existing public disposal facilities be closed as soon as the proposed new sanitary landfill facilities are ready for service.

2. The City of Urbandale operates a small completely nuisance free sanitary landfill in a City Park west of 72nd Street and south of Interstate No. 80 and No. 35. This site is operated primarily for the disposal of City collected kitchen waste from the dwellings within the City. It also receives

some other waste from City operations and from residents of the City by appointment.

The City is operating the site as a satisfactory method of disposing of its waste but at a high unit cost. The high cost is due to the relatively little waste that is being handled. A piece of heavy equipment and an operator is used to do the work. The same operator on a large piece of landfill equipment at a large site could handle 100 or 200 times as much material in the same amount of time.

The cost of operation and tonnage disposed of are estimated to be $10,000 and 2,500 tons per year. At this rate the cost of operation is $4.00 per ton which is approximately four times the expected rate at the new sanitary landfill sites. It is believed the new sites will be attractive to this City.

3. The Polk County site is located on a relatively small parcel of leased land adjacent to Four Mile Creek and NE 78th Avenue, approximately 1 1/2 miles east of I-35. Several activities are conducted at this site. A trench sanitary landfill is operated for garbage and some other material. Large items of noncombustible trash are dumped on an exposed hillside with the open exposed surface visible from the road. Combustible materials such as brush, tree limbs and lumber are burned under the control of the site operator. Although open burning is considered objectionable, this operator takes great care to burn in the least offensive manner. There is also a depression in the ground in which highly flammable liquid wastes are burned. Except for the burning and exposed trash on the hillside, the site is maintained in a neat and attractive manner. The grass is well maintained and the area enclosed in a suitable fence. See Part Two for land fill survey information.

The site is operated for the benefit of the residents and commercial and industrial concerns located in the unincorporated parts of Polk County. The following fees per load are charged: pickup trucks, $1.50; dump and flat bed trucks etc., $3.00; packer trucks $6.00; Private citizens, free. Also special rates are arranged for unusual wastes.

This site, like the Urbandale site, is an expensive operation when considering unit costs. It is maintained as a necessity but could be closed when the new sites are available.

4. The Euclid Avenue site is located east of the Des Moines River on the south side of Euclid Avenue. This site is operated by a private individual on leased land. The site is open to the public upon payment of a small fee which varies from 25¢ per automobile to higher amounts for larger loads.

The site is an open burning dump. Little or no attempt is made to cover material and burning is practiced as a method of volume reduction. A landfill survey was conducted at this site. Information is contained in Part Two of this report.

Although this operation is a convenience to the public, it should not be permitted to operate in its present form.

5. The Ankeny landfill is located on the sewage treatment plant site south of the John Deere Plant. The land is owned by the City of Ankeny and open to residents and commercial and industrial establishments located in Ankeny and to private haulers collecting waste from within the City.

The operation is a semi-sanitary landfill with open burning under controlled conditions practiced as a volume reducing procedure. Partial covering is accomplished several times per week, using ashes waste dirt and dirt taken from the site. There is adequate space on the site to continue in this location.

This site could be converted to a satisfactory sanitary landfill if the burning was discontinued and the active face was adequately compacted and covered with earth daily. In addition, road improvements, fencing and site maintenance need to be accomplished, to provide proper access and appearance.

From the site survey, it was determined that this site receives solid waste at the rate of approximately 9,000 tons per year. The cost of this site operation as reported by the City is approximately $14,000 per year, not including payroll overhead or land cost. The cost per ton based on the incomplete reported cost is $1.55. This cost is 40% higher than the cost of the recommended public landfill sites. This higher cost is due to the low tonnage filled. There is little which can be done to improve the economics and in fact, if the necessary improvements are made in the operation the cost will increase. It is believed that the City of Ankeny would benefit by closing this site when the new public sites are available.

6. The West Des Moines site is a collection of three site operations on the edge of a sand pit located southeast of the C.R.I. & P. Railroad at approximately 11th Street extended. The land is leased from its owner for a nominal annual fee. This facility is used by citizens and commercial and industrial concerns located within the City and by the City for disposal of collected garbage and other City solid waste.

As a regular practice, trees and combustible liquids are burned. Occasionally trash is also burned. An attempt is made to keep garbage separate from other materials and to compact and cover it as cover material is available. There are three basic problems.

a. There is inadequate land at this site to continue filling.

b. The site activity can and probably does contaminate the ground water at this location.

c. There is an inadequate supply of cover material available or reasonably accessible to properly conduct a sanitary landfill operation.

An attempt is made to operate a semi-sanitary landfill site. However, this operation is unsatisfactory when compared to proper sanitary landfill criteria. The lack of adequate cover material is difficult to overcome. In addition, the uncovered materials are a health and litter hazard, and occasionally catch fire. Without adequate cover material to enclose the daily quantities into cells to prevent the spread of fire, there are inadequate quantities to smother a surface fire.

Based on the landfill survey discussed in Part Two, this site receives solid waste at the rate of approximately 40,000 tons per year. The cost of operation is approximately $12,000 per year or $.30 per ton. Although this cost is cheaper than that proposed, the operation cannot be economical if proper standards are observed.

It is recommended that the site be closed as soon as the new proposed sites are available for use.

7. The Des Moines Site No. 2 is located in a worked out quarry south and west of SE 30th & Maury Streets. This site is one of two operated by the City of Des Moines. It is open to the general public without charge. Materials accepted at this site are restricted to materials such as building demolition, broken concrete, trees and limbs, tires and similar items. This site receives approximately 45% of all of the tonnage and 36% of all the volume of waste, considering all disposal sites in the entire Study Area. The waste consists largely of trees and tree limbs.

The site has little cover material available. The cover used is hauled to the site in trucks. The lack of adequate cover material is compounded by the type of material filled. One feature of sanitary landfilling and specifically compacting the waste material, is that unlike materials compact better than like materials. For example, 1000 rubber tires or 1000 tree trunks will not compact into a tight dense mass. However, when mixed together with several hundred tons of other materials of different sizes and shapes into a heterogeneous mass, it becomes much easier to compact. Smaller items are packed into the center part of the tires and between the tree trunks. Few tree trunks are actually in contact with each other, thereby eliminating the see-saw problem.

At this site large quantities of earth are required to pack around the great number of logs to be able to travel over the mass with a machine.

Because this site was a former quarry with standing ground water above the floor of the pit, the site was restricted to materials which would not contaminate the ground water. Actually restricting a site to certain materials is difficult to police. Unauthorized material such as some garbage mixed with inert material has been observed at this site. Similarly, cardboard boxes and other material which will dissolve when inundated are also deposited in restricted quantities.

This site was leased at a nominal rate per year and placed into service to conserve the limited capacity remaining at the Des Moines Site #1. Operating two sites relatively near each other is expensive and wasteful, but in this case necessary. A great effort is made to operate this site in an acceptable manner but the results are unsatisfactory due to the handicap of having to handle homogeneous materials without sufficient quantities of cover dirt. There is also a lack of adequate landfill equipment. The equipment owned by the City is not sufficiently large or rugged to do the heavy job required at this site. The percent availability is unacceptably low due to continuous breakdown. A track mounted bulldozer rented from a contractor has been used at the site, working side by side with track mounted dozers owned by the City. The contractor's machine which is a rugged heavy duty type has a negligible amount of breakdown.

The site is rapidly filling and at the current rate will be completely filled by 1970. Part Two contains detailed information obtained during the site survey.

8. The Des Moines Site No. 1 is located east of SE 15th Street at Harriett Street, on City-owned land. This site is open to the public without charge and accepts all waste materials except tree waste and large quantities of demolition waste which are diverted to Site #2.

One third of the tonnage and approximately 43% of the volume of waste from the entire Study Area is received and handled at this site. See Part Two for site survey information.

A few years ago this site was a typical example of a large unregulated burning dump. It was the type of operation responsible for the poor public image of landfills. In recent years the operation has been improved and great progress made toward bringing the site up to a decent standard. The current status is far from acceptable but improving rapidly. Based on recommendations submitted in mid-summer 1967, the operation has been further improved.

The principal problems at this site are the lack of cover material, and inadequate equipment. There is no cover material left at the site, and therefore all cover must be trucked in. The City has a fleet of 2-1/2 ton dump trucks which are normally used for street department work. This is an appropriate size for street use, however, hauling cover material under "off the roads" conditions is an abuse of this type of equipment and produces a small quantity of material. A heavy duty 10 to 15 cubic yard truck requires the same driver as a 2-1/2 ton truck but will haul much more material. It is built for the rugged operating conditions and on a tonnage hauled basis is cheaper to operate.

The City has diverted all of the trucks not being used for other necessary work to the task of hauling cover for this site. This has made a significant improvement in site operations.

Fires have been a problem at this site for many years. Formerly they were purposely set or allowed as a volume reducing procedure. Currently fire prevention is practiced and great efforts are made to extinguish fires that do occur.

With more dirt available and cell construction progressing, fires are being controlled better than before, but any fire is unacceptable. A proper sanitary landfill does not burn at any time. Any small fires are quickly extinguished by smothering or by digging out and smothering. Under present conditions when a difficult fire breaks out in deep layers of waste, it may burn for weeks before burning itself out or finally being smothered by the operators. Fighting such a fire takes all of the resources of the operating forces and equipment, leaving the disposal operation unattended. With adequate compaction and cover, fires are no problem.

From an economical standpoint, this site should have been closed when the supply of cover dirt was exhausted. Trucking in large quantities of cover dirt is expensive but under the circumstances is necessary. It is recommended that no attempt should be made to acquire new landfill sites until this site is converted to a model sanitary landfill. The reasoning and necessary improvements, together with financing, are explained in following paragraphs concerning interim improvements.

Once the new landfill sites are acquired and operating, this site should be closed. Until that time the site must be continued in operation.

9. Other Disposal Operations. Three small disposal sites are operated by the towns of Carlisle, Norwalk and Pleasant Hill. They are operated primarily for the use of local residents. Norwalk and Carlisle permit local private haulers to dump domestic waste collected from their communities. Pleasant Hill does not.

Pleasant Hill provides an attendant on duty full time; Carlisle and Norwalk provide an attendant part time. Carlisle and Pleasant Hill allow burning of combustible waste as a method of volume reduction. Cover is applied approximately once weekly. Norwalk buries all waste, except tree wastes, in an open trench which is covered about once a month. No burning is allowed except for tree wastes which are burned on an irregular basis.

All three of these operations, although providing a convenience to the local residents, are uneconomical. In addition, they all have various objectionable features which would be expensive to correct. When new facilities become available, these three operations should be discontinued.

The other communities in the Study Area do not have disposal facilities. They require the private collectors to remove the collected waste from the community. Usually the material is delivered to the Des Moines Site No. 1.

E. Interim Improvements to Existing Operation. Improvements should be made in most of the existing disposal operations as soon as possible. Although it is recommended that all of the present facilities be closed when the new sanitary landfill sites are in operation, the interim period should be used to improve the image of landfill sites. In the previous paragraphs deficiencies in the existing sites were discussed. These deficiencies should be improved if financially possible. Specifically, in the case of the two Des Moines Sites, the operations should be converted to model sanitary landfills.

To operate a proper and economical sanitary landfill, many techniques are required. Many of these same techniques will be required for interim improvements to existing sites. Some of the comments in this section are not practical for a small landfill which will be closed, but the largest single factor is an awareness of what is going on and what can be done. Municipal officials can learn much by simply taking a close and critical look at their facilities.

It will be necessary to establish new sanitary landfill sites in locations where none are presently located. This will require public approval. At the present time, if any one of the cities or counties involved in this study were to attempt to establish a major sanitary landfill operation near a developed area, there would be immediate public resistance. This has been experienced in other communities, but need not be the case. A course of action is recommended which, if followed, will substantially improve public acceptance.

Public reaction to sanitary landfills is generally negative. This is a response resulting from the operation of undesirable public and private dumps. The City of Des Moines and other communities in the Study Area have been guilty of operating undesirable dumps for many years.

Sanitary landfills are not dumps. There is no burning, smoke, litter, odors, vermin, unsightliness, mud or dust. They are regulated and orderly, efficient, inexpensive and nuisance free.

It is believed that the public can be convinced only by demonstrating to them, in their own community, what a proper facility is like, and then making them aware of the accomplishment. The Des Moines Dump Site No. 1 is better than it was just a few years ago.

Burning as a volume reduction method has been discontinued and efforts are being made to extinguish fires which occur accidently. The site has become better organized and more covering is being done as more cover material is brought to the site. The site is being graded and policed for litter from time to time. All of these improvements are a credit to the current management.

It will be necessary to continue these improvements until the complete operation has been elevated to a model sanitary landfill. No attempt should be made to acquire new land until this has been accomplished. Once this improvement has been made every effort should be made to acquaint the public with the new operation.

Normally the first item to be accomplished would be to master plan the ultimate use of the site so required operational development could be coordinated with future uses. The 1980 Comprehensive Plan provides for this site to be part of the open space and recreation land along both rivers through the City. Current improvements such as fences, roads, drainage and landscaping should be laid out now for this ultimate development.

The interim use of land not currently being filled should be directed toward the public open space use to show that sanitary landfill operations can be conducted close to public uses without being a nuisance.

The interim improvements necessary to bring the operation up to sanitary landfill standards are as follows:

1. Continue efforts to prevent fires and promptly extinguish all which start. Fires cause smoke and are visibly bad publicity in addition to the air pollution and odor.

2. Consolidate all filling operations into one location with one active face.

3. Instruct the operators and foremen in the proper operation of a sanitary landfill site. This will include the necessary philosophy, objectives and goals; compaction techniques; cell construction; covering; grading; placement of drift fences for litter control; fire fighting with cover dirt and digging out fires; and traffic controls.

4. Build up the roads to improve their ability to support traffic in wet weather. The roads have been improved but they are in need of additional improvement. Dirt and gravel brought to the site can be used to raise the subgrade to an elevation which will permit drainage of the surface. The site has a motor grader and dozers to do this work. The road grade can be increased a small amount at a time and allow the site traffic to do the compaction.

5. Establish a traffic pattern and erect signs and fences to guide the traffic to the place of deposit being used at the time.

6. Fine grade the area along both sides of the perimeter fence and maintain the grass in an attractive manner.

7. Police the area around the perimeter fence and entrance roads for litter. This should be done daily. Refuse truck crews finishing early can be used for this purpose until the routes have been redesigned to eliminate slack time.

8. Provide and use portable fencing (snow drift fencing will be adequate) to control blowing litter in the active disposal area and at other places where necessary. Pick up litter on the site on a continuous basis.

9. Eliminate and prohibit salvage operations. A properly operated site has very little material accessible to salvagers and salvagers cause a congestion problem. It is also dangerous to have salvagers working in the vicinity of a landfill machine. On occasion salvagers have been accused of starting fires to burn away paper to expose salvable metals. If salvaging is eliminated this problem is avoided.

10. Spray for insect control and provide poison for rodent control.

11. Establish and enforce complete and meaningful policies and regulations concerning sanitary landfill operation. Make these policies and regulations available and known to the operators and to the public.

12. Erect attractive and informative signs at the site to inform the public and users of necessary regulations and instructions.

13. Make provisions to pave the two entrance roads to the landfill site from SE 14th Street and from Maury Street. Provide modern street lighting along these entrance streets.

14. Clear, grub and fine grade all of the lots owned by the City in the vicinity of the site. These lots are now overgrown with weeds. Once the lots are fine graded plant them to grass and maintain the appearance.

15. Enforce all zoning and building ordinances and regulations in the vicinity of the site.

16. Provide adequate cover material to cover the active face every day. At least 500 cubic yards of cover will be required each day. It will be necessary to acquire suitable loading and hauling equipment.

17. Provide more suitable and reliable landfill equipment.

18. As areas are covered they should be graded to drain and planted with grass and kept mowed.

Many of these items have been started and some have had a degree of success. Also, many of the details such as quantities of cover material, trucks and dozers have been discussed in detail with Des Moines officials together with detailed procedures and cost estimates. Most of the items have appeared in interim reports and suggestions as this study progressed.

This work must be accomplished now. The site is not economical to operate. It must be improved, publicized and used as an example of what can be done so new sites can be acquired. Then this site should be closed for use as a disposal facility.

F. Financing Interim Improvements. Currently, the landfill operations of the various communities are financed by budgeted amounts raised through taxes, with the exception of the Polk County site which is supported by Township Tax Levy along with fees, and the Euclid Avenue site which is supported entirely by fees.

It is not practical for the various small communities to charge fees because the policing and collection cost could exceed the revenue. Interim improvements to the several small sites should be simple, relatively inexpensive and paid for out of operating funds.

The larger sites, specifically Des Moines Sites Nos. 1 and 2 which receive and handle more than 3/4 of the total Study Area waste will require more funds than are currently being spent. Although the Des Moines landfill budget for 1967 was in excess of $150,000, this amount will be inadequate to make the necessary improvements and operate the improved facilities, which are estimated to cost approximately $245,000 per year plus the purchase of $190,000 worth of new equipment.

It is believed that a substantial portion of these funds should be raised through a fee system whereby the users of the facility pay the cost of operation. The details of the cost of operation and equipment and the fee system and expected revenue are explained in a letter to the City of Des Moines, Director of Public Works dated January 25, 1968, and is included in the Appendix as Exhibit 4-1.

It is recommended that a simple fee system be installed for the interim period of time the sites are to be operated. This system charges $1.00 per vehicle for pickup trucks and light trailers; and $2.00 per vehicle for other trucks. No charge would be made for automobiles or City vehicles. However, it is recommended that Des Moines continues to budget an amount equal to the fee the City trucks would have paid if fees were collected on these vehicles. Under the fee system proposed revenue in the amount of $287,000 can be expected.

Since the City of Des Moines maintains an "open door" policy, allowing anyone to use their facilities, the charge of a small fee as proposed is reasonable.

The concept of charging a small fee has been discussed with the private haulers in the Study Area. Although this exact fee was not contemplated at the time, the general attitude was one of acceptance. They expressed a desire for road and cover improvements which would reduce their costs of repair to tires and power trains.

It is believed the fee will be accepted by the majority of the users without protest when they see that this fee will continue the present improvements and extend them to higher standards.

G. Selecting General Areas for New Sanitary Landfill Sites.

1. General. Two general areas have been selected for sanitary landfill sites as shown in Figure 4-1. One site would be located in each general area. The northeast site would serve that area which is north and east of the time line, and the southwest site would serve that area which is south and west of the time line.

The general areas were selected using the following criteria:

a. Minimum driving time from centroid to site area.

b. Present zoning and land use compatible with sanitary landfilling.

c. Accessible to major highways or arterial streets.

d. Economical land cost.

e. General topography, including terrain, ground cover, drainage, ground water and major subsurface conditions.

f. Suitable earth cover available.

2. Centroids. Centroids were computed to determine the theoretical locations from which the waste was being originated. These centroids were computed for all of the waste being sent to each site which was surveyed. They are also shown in Figure 4-1 and labeled "Waste Centroid - (name of site) Disposal Site". A centroid was also computed for

all of the wastes from the entire Study Area. This centroid is shown on the figure and labeled "Waste Centroid Total Study Area". The ideal location for a single disposal activity would be at this Total Study Area Centroid. It represents the theoretical origin of all the waste. This location would represent the single point which would have the least amount of hauling.

There is no land within several miles of this centroid that would be suitable for a single large sanitary landfill site, therefore it was necessary to consider multiple sites. (See Exhibit 4-2 for cost discussion).

An attempt was made to find two general locations for potential site development which would best meet the criteria and be on opposite sides of the community with the centroid located at a point between them. The two recommended general areas meet the criteria very well. They are on opposite sides of the Study Area with the centroid on a line almost exactly halfway between them.

The time line as drawn on Figure 4-1 represents a locus of points, each of which is approximately equal in driving time to the two recommended general areas. The time line divided the Study Area into two areas, one is the area which would contribute waste to the northeast site, and the other is the area which would contribute waste to the southwest site. Computer Program "G" was used to determine the centroids of the waste originating in each of the two areas. The "Waste Centroid New Southwest Area" and "The Waste Centroid New Northeast Area" are shown in Figure 4-1. These centroids represent the theoretical center of waste origin that would contribute waste to the southwest and northeast sites respectively.

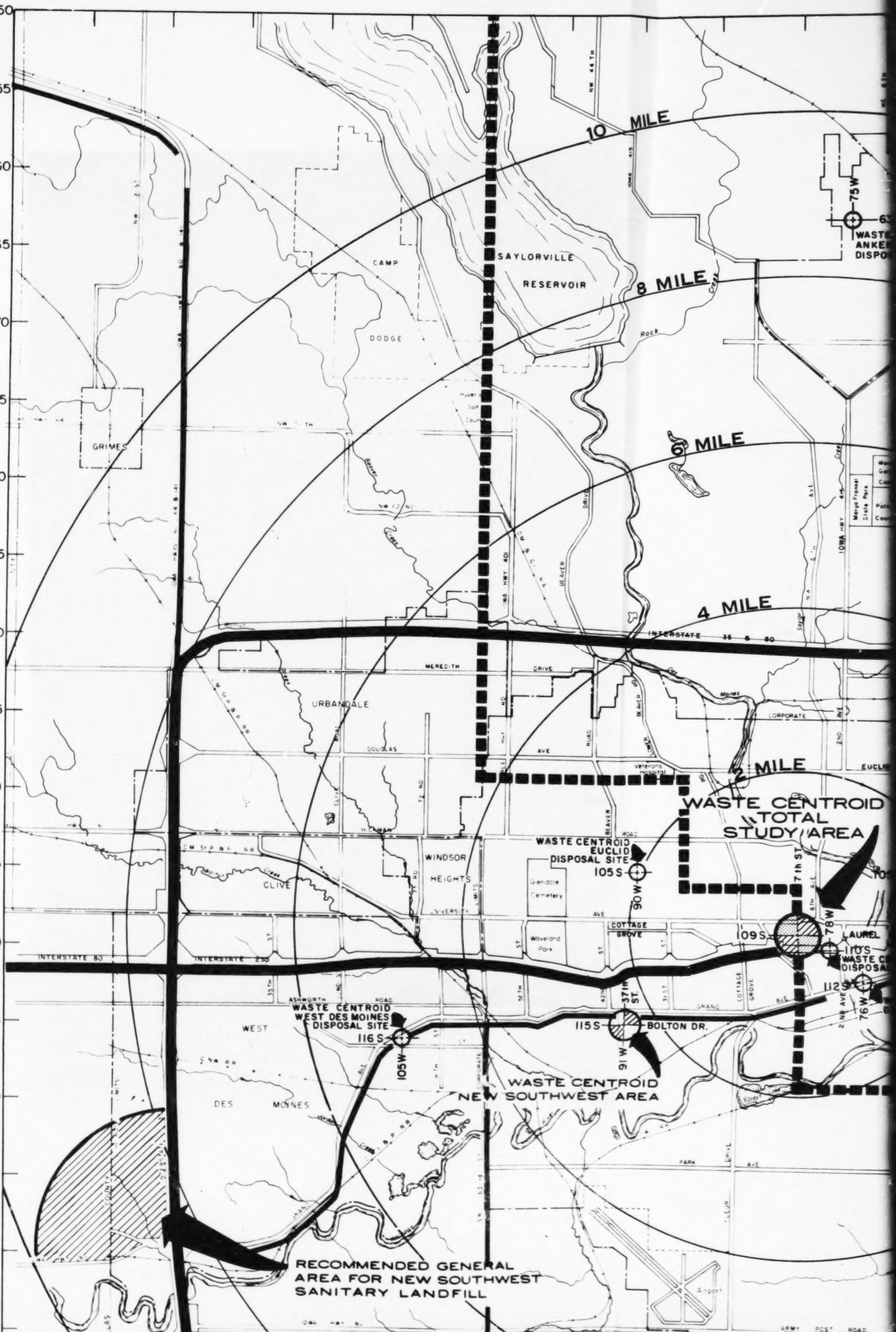
3. Driving Time. The driving time from the southwest centroid of waste in the new southwest area, to the recommended southwest general area where a site is to be located, is approximately 13.6 minutes. This is based on 45 mph on the Interstate and 20 mph on city streets. The time was figured from the centroid at 37th Street and Bolton Drive, to the intersection of I-35 and Iowa 90.

The driving time from the northeast centroid at East 14th and Osceola Streets, to the recommended northeast general area at the intersection of I-80 and U.S. 65, is 10.5 minutes.

These very favorable driving times are the result of locating the recommended general site areas in places which have ready access to the Interstate Highway System.

4. Zoning and Land Use. The northeast general area is presently used for agricultural purposes. This land is located in an unincorporated area under the zoning jurisdiction of Polk County. A substantial portion of the area is zoned agricultural and has provision for establishing a sanitary landfill under a permit provision.

A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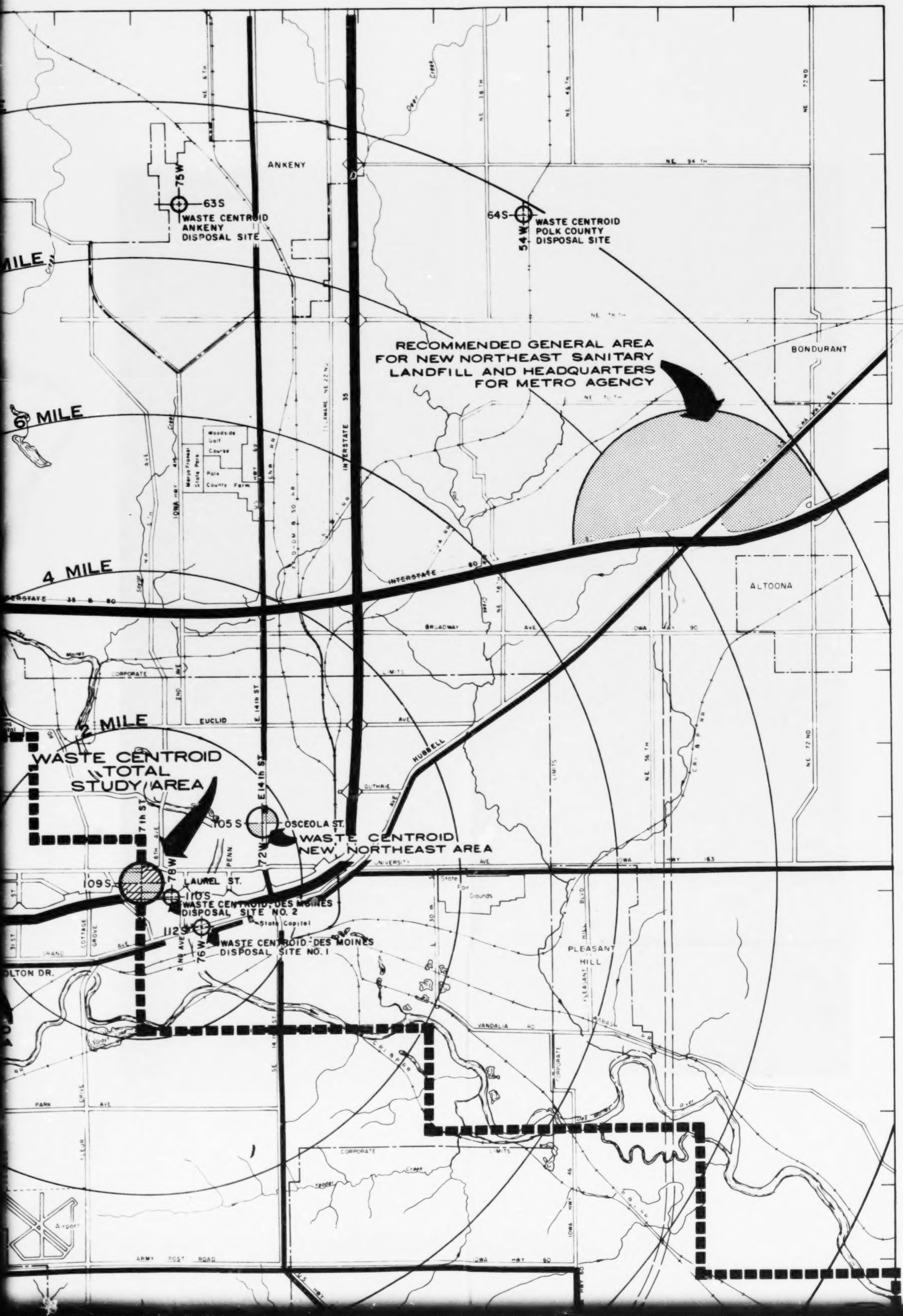
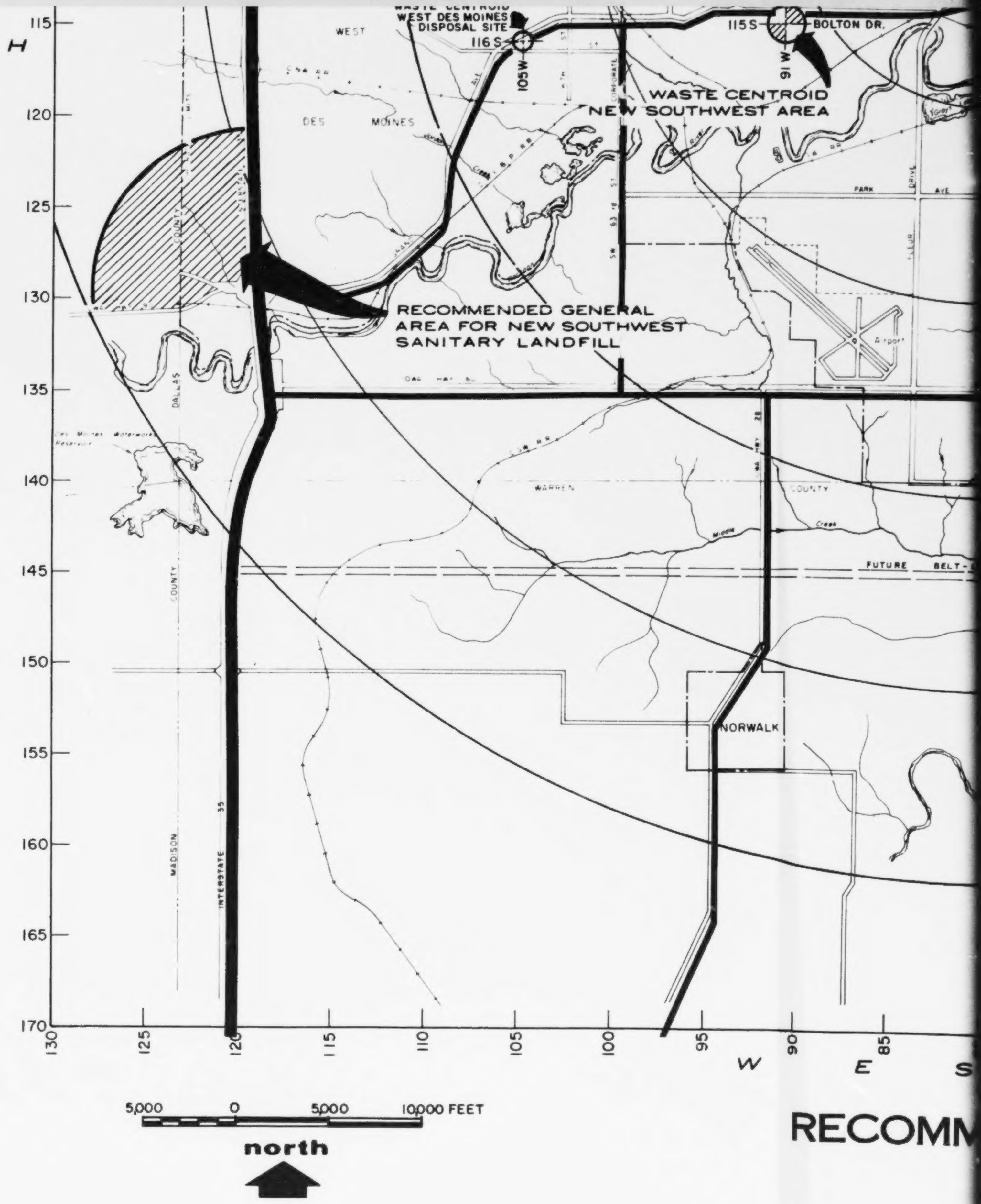
10 MILE
8 MILE
6 MILE
4 MILE
2 MILE
SAYLORVILLE
RESERVOIR
CAMP
DODGE
GRIMES
NW 44TH
75W
63
WASTE
ANKE
DISPO
Rock
Creek
INTERSTATE 35 & 80
MEREDITH
DRIVE
URBANDALE
CORPORATE
DOUGLAS
AVE
EUCLI
Veterans Hospital
WASTE CENTROID
TOTAL
STUDY AREA
7th ST
WASTE CENTROID
EUCLID
DISPOSAL SITE
105S
90W
WINDSOR
HEIGHTS
CLIVE
Glendale Cemetery
UNIVERSITY
AVE
COTTAGE
GROVE
Waveland Park
109S
78W
LAUREL
110S
WASTE C
DISPOSA
112S
76W
INTERSTATE 80
INTERSTATE 235
ASHWORTH ROAD
GRAND
WASTE CENTROID
WEST DES MOINES
DISPOSAL SITE
WEST
116S
105W
115S
37TH ST.
91W
BOLTON DR.
WASTE CENTROID
NEW SOUTHWEST AREA
DES MOINES
PARK AVE
Airport
RECOMMENDED GENERAL
AREA FOR NEW SOUTHWEST
SANITARY LANDFILL
DALLAS
ARMY POST ROAD

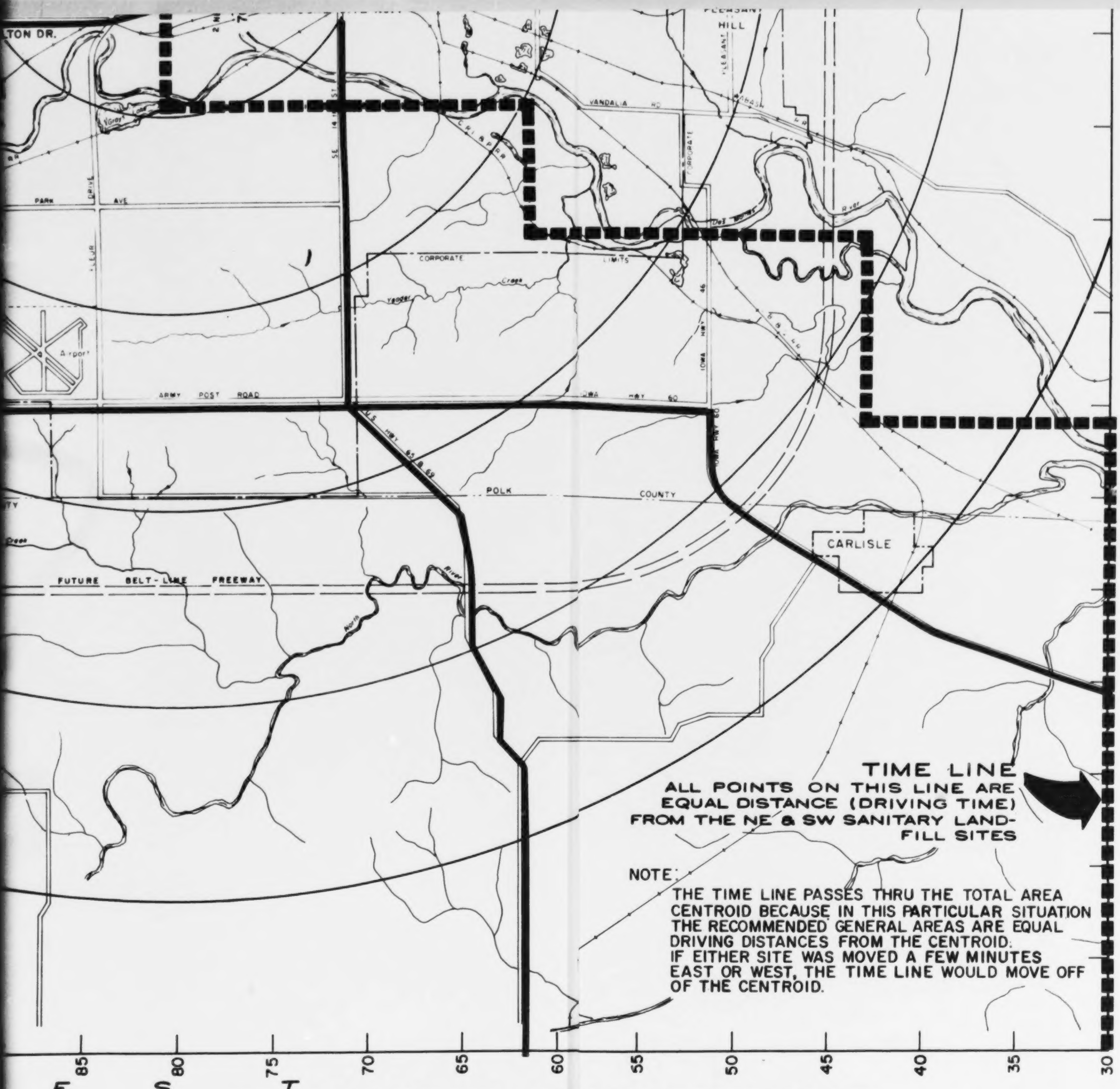
B


RECOMMENDED GENERAL AREA FOR NEW NORTHEAST SANITARY LANDFILL AND HEADQUARTERS FOR METRO AGENCY
ANKENY
75W
63S
WASTE CENTROID ANKENY DISPOSAL SITE
64S
54W
WASTE CENTROID POLK COUNTY DISPOSAL SITE
MILE
6 MILE
4 MILE
2 MILE
BONDURANT
ALTOONA
PLEASANT HILL
WASTE CENTROID TOTAL STUDY AREA
105S
OSCEOLA ST.
72W
WASTE CENTROID NEW NORTHEAST AREA
109S
78W
LAUREL ST.
110S
WASTE CENTROID DES MOINES DISPOSAL SITE NO. 2
112S
76W
WASTE CENTROID DES MOINES DISPOSAL SITE NO. 1
INTERSTATE 35
INTERSTATE 35 & 80
INTERSTATE 80
BROADWAY AVE
IOWA HWY 90
EUCLID AVE
HUBBELL AVE
GUTHRIE AVE
UNIVERSITY AVE
IOWA HWY 163
E. 14th ST
7th ST
6th AVE
PENN
2ND AVE
GRAND AVE
COTTAGE GROVE
31 ST
BOLTON DR.
VANDALIA RD
PARK AVE
ARMY POST ROAD
IOWA HWY 60
IOWA HWY 46
NE 6TH
NE 38 TH
NE 46 TH
NE 72 ND
NE 94 TH
NE 78 TH
NE 70 TH
NE 56 TH
NE 72 ND
DELAWARE
IOWA HWY 64
Woodside Golf Course
Margo Frankel State Park
Polk County Farm
State Fair Grounds
State Capitol
PLEASANT HILL BLVD
CORPORATE LIMITS
Des Moines River
Deer Creek
Airport


WASTE CENTROID
WEST DES MOINES
DISPOSAL SITE
116S
105W
115S
91W
BOLTON DR.
WEST
DES
MOINES
WASTE CENTROID
NEW SOUTHWEST AREA
PARK
DRIVE
AVE
Airport
RECOMMENDED GENERAL
AREA FOR NEW SOUTHWEST
SANITARY LANDFILL
IOWA HWY 60
SW 63rd ST
CORPORATE
DALLAS
COUNTY
Des Moines Waterworks Reservoir
WARREN
COUNTY
Middle Creek
FUTURE BELT-
NORWALK
MADISON
INTERSTATE 35
IOWA HWY 28
H
115
120
125
130
135
140
145
150
155
160
165
170
130
125
120
115
110
105
100
95
90
85
W E S
5,000 0 5,000 10,000 FEET
north

RECOMM

326-677 O - 68 (Face p. 124) No. 2


TON DR.
PLEASANT HILL
VANDALIA RD
PARK AVE
CORPORATE LIMITS
Yeader Creek
Airport
ARMY POST ROAD
IOWA HWY 60
IOWA HWY 46
U.S. HWY 65 & 69
POLK COUNTY
CARLISLE
FUTURE BELT-LINE FREEWAY
North River
Des Moines River
85
80
75
70
65
60
55
50
45
40
35
30
E S T

TIME LINE
ALL POINTS ON THIS LINE ARE EQUAL DISTANCE (DRIVING TIME) FROM THE NE & SW SANITARY LANDFILL SITES

NOTE:
THE TIME LINE PASSES THRU THE TOTAL AREA CENTROID BECAUSE IN THIS PARTICULAR SITUATION THE RECOMMENDED GENERAL AREAS ARE EQUAL DRIVING DISTANCES FROM THE CENTROID. IF EITHER SITE WAS MOVED A FEW MINUTES EAST OR WEST, THE TIME LINE WOULD MOVE OFF OF THE CENTROID.

CENTROIDS OF WASTE AND
RECOMMENDED NEW SANTARY LANDFILL AREAS
FOR STUDY AREA

D

FIGURE 4-1

The southwest general area is partly in Dallas County and partly within the City of West Des Moines. That part in Dallas County is zoned Residential, although the land is used primarily for agricultural purposes. That part within the City of West Des Moines should be reviewed with City officials due to pending zoning changes. The current use is primarily agricultural.

5. Accessibility. Both recommended general site areas have excellent access from I-80, I-35 and I-235 as well as U. S. and Iowa highways and major arterial streets. With major thoroughfares to carry the traffic, the problem of increased heavy traffic over local streets is avoided. Some improvement in local roads in the immediate vicinity of the sites will probably be required; however, in these two areas such improvement will be minimal.

6. Land Cost. In both areas, the land is now used for agricultural purposes and is not highly developed. The northeast area is generally flat land now planted to row crops. Land in this area is estimated to cost approximately $1,200 per acre. The southwest area is generally hilly with some land in row crops, some in pasture and some in rough brush and thicket. The gully land which would be suitable for sanitary landfilling is estimated to cost approximately $1,000 per acre.

Using these estimated prices for land, when estimating the cost of sanitary landfilling, the land cost is less than 10% of the total cost. These costs appear economical.

7. General Topography. The northeast general area is relatively flat farm land. There appears to be no serious problems with drainage of the general terrain, ground cover or ground water. There are no subsurface conditions known to be detrimental. This general area could be used for multiple layers of refuse filled in the usual manner.

The southwest general area has rough land which could be filled using gully techniques. The surface drainage would require relocation; however, this could be accomplished at minimal expense during the initial development of a site and while removing earth for cover. There are no problems anticipated from ground water or ground cover. There are no subsurface conditions known to be detrimental.

8. Earth for Cover Material. Both general areas have abundant supplies of earth which would be suitable for cover materials.

9. Capacity Requirements for Each Disposal Site. The time line described in preceding paragraph 2 divided the Study Area into two general areas. Computer Program "G" determined the amount of waste which would originate in each of the two areas. The northeast area would receive approximately 62% of the waste. The southwest area would receive 38% of the waste. Because the growth of the area and the future waste quantities will be developing generally westward, these percentages were adjusted to 60% and 40% respectively.

The 1968 through 1987 accumulation of waste is estimated to be 15,000 acre ft. Therefore, the following capacities are required:

NE Site 15,000 x .60 = 9,000 ac. ft.
SW Site 15,000 x .40 = 6,000 ac. ft.

H. Selecting Specific Parcels of Land. This report does not show specific parcels of land, located in the recommended general areas, which are recommended for development into sanitary landfill sites. Specific parcels should be selected after detailed site selection analyses based on the following items:

1. Amount of land required.
2. Availability of cover material.
3. Cost of the land.
4. Subsurface conditions, including type of soil and ground water.
5. Cost of initial development.
6. Cost of annual development.
7. Cost of operation.
8. Potential use or sale of filled land.

There are specific sites which have been considered, that can be properly developed and used. These specific sites were used as a basis to show how a flat site could be developed in the northeast general area and how a gully site could be developed in the southwest general area. The two sites described in the next sections of this report are included as illustrations of development and to determine the amount of land required and the cost estimates, used for preliminary planning. It is not intended that the final development of either site be exactly as shown. The details of development will depend on engineering designs for the specific parcels of land actually purchased after detailed site evaluations.

I. Development of a Site in the Northeast Area.

1. General. The land in this area is generally flat and therefore suitable for development using multiple layers of waste. The cover material can be taken from the land in a cut and cover type operation. The site must accommodate 9,000 acre ft. of waste during the 20-year period from 1968 through 1987.

2. Amount of Land Required. The amount of land required depends on the amount of waste and the depth of fill, plus additional land for roads, setback, sight screening and landscaping and operational spaces. It is assumed that the land purchases will require purchasing full parcels of land which would be not less than 40 acre increments. Therefore, in addition to the land actually needed, it may be necessary to purchase additional land to take an even parcel.

This type of site can be developed for multiple layers. We have selected a total depth of fill of 50 feet consisting of 5 lifts of 10 feet each. It is estimated that 20% additional land will be required for roads, setback, sight screening, etc. The total land purchase is estimated as follows:

a.	Land for filling	
	9,000 ac. ft. ÷ 50 ft. =	180 acres
b.	Roads, etc.	
	180 acres x 20%	36
	Subtotal	216
c.	Additional land for even parcel purchases	24
	Total Land to be Purchased	240 acres

Based on a purchase of 240 acres, we have assumed the land would consist of a quarter-section (160 acres), plus a half of a quarter-section (80 acres); measuring one-half mile (2,640 ft.), by three-quarters of a mile (3,960 ft.).

3. Initial Development of the Site. Before any operations can commence, the site must be designed and developed. We would recommend that the initial development be done by a contractor following plans and specifications prepared by an engineer. The initial development would consist of the following items:

a. Scale house, gate house and scale equipment.
b. Equipment and personnel facilities.
c. Agency headquarters.
d. Water supply and mains.
e. Fencing.
f. Roads and drainage.
g. Grading and landscaping.
h. Yard and street lighting.

In the cost estimates which follow, the initial site development is estimated to cost approximately $200,000. Some of the initial site development is shown in Figure 4-2, which illustrates the development of a flat site into a sanitary landfill.

The items listed above are self-explanatory or discussed elsewhere except for the grading and landscaping. One major grading item would be the construction of a sight screening berm around that part of the site which will be filled first. As filling progresses, the berm will be extended. The urpose of the berm is to completely screen the site operations from view from the road. It will also act as a windbreak to aid litter control. The berm should be planted to grass or some suitable ground cover. The berm and the area between the berm and the property line should be landscaped with trees and shrubs. The construction of the berm and the landscaping are necessary parts of the entire operation and add substantially to the public acceptance. The expense of these items are very small when compared to the operational cost.

4. Operation of the Site. The amount of earth needed for daily cover, final cover, berms and roads is approximately 4 1/2 million cubic yards over a period of 20 years. Taking this earth from the fillable area requires a cut of approximately 13.4'.

Starting at Elevation -13.4 ft. and adding 10 ft. of waste and 8-inches of cover for each lift, the approximate levels for the fills would be as follows:

Lift	Bottom	Fill		Top
First	-13.4	+10.7	=	- 2.7
Second	- 2.7	+10.7	=	+ 8.0
Third	+ 8.0	+10.7	=	+18.7
Fourth	+18.7	+10.7	=	+29.4
Fifth	+29.4	+10.6	=	+40.0
Final Cover	+40.0	+ 3.0	=	+43.0

The landfilling can start at Elevation -13.4 in the area where the initial development earth was excavated. As this space is being filled, the cover dirt required is excavated from the immediately adjacent space, thus creating additional area with a bottom elevation of -13.4.

The filling should be from the bottom of the lift with trucks dumping at the foot of the active face and the dozer compacting and pushing the waste up from the bottom. This bottom dumping has advantages over dumping at the top and pushing the waste down the slope.

The active face should be between 150 and 200 feet wide depending on the traffic. As the first lift is filled over an area approximately 200' wide x 1,000' long, the top surface of the first lift becomes available for the second lift. When this first 200' x 1,000' pass of the first lift is complete, the second lift should start. The second lift can be filled to an elevation of +8.0'. It starts at the same place the first one started and can cover the same 200' x 1,000' except for maneuvering room needed around the edges. By the time the second lift is complete to the extent it has covered as much of the first lift as possible, the filling can return to the -13.4' elevation in the space excavated while the first and second lifts were being filled. This second pass on the level of the first lift will widen the top surface of the first lift to the extent that additional area is available for the second pass of the second lift. Once this second pass of the second lift is completed, the third lift can be started on top of the second lift.

The process of building lift upon lift and then returning to the bottom to widen the base is necessary to build up to the top of the fifth lift as soon as possible. It is at this +40.0' level that the final earth cover is placed. This cover material amounts to approximately 1/4 of the total earth moved. Therefore, it is desirable to reach the top as soon as possible so excavated material from the -13.4' level can be brought directly to the +40.0 level without rehandling.

In Figure 4-2, the site operation is shown. The first view shows the site after the first few months of operation. The first pass of the first lift has been completed. The first pass of the second lift is in progress while additional cut is being made on the -13.4' level.

The second view shows the site after approximately one year. The +40.0' level has been reached. The operation from this stage until the completion of this area consists of widening the base and adding additional lifts on top until the area has all been filled to elevation +40.0'.

The third view shows this area filled and the operation moved to the adjacent area on the opposite side of the fill road.

The fill road leading from the scale and entrance area to the fill area would be built in the initial development to an elevation of +10.0. As the third lift was placed, the road would be raised to reach the top of the third lift at elevation +18.7' for access to this level, when the fourth lift was started. It would be raised again during the fourth lift and again during the fifth and last lift.

J. Development of a Site in the Southwest Area.

1. General. The land in this area is hilly containing several large gullies which could be developed using typical gully filling methods. Cover material can be taken from the gully bottom and sides in a combination cut and cover and borrow type operation. The site must accommodate 6,000 acre feet of waste during the 20-year period from 1968 through 1987.

2. Amount of Land Required. The amount of land required depends on the depth of fill plus additional land for roads, setback, drainage, sight screening and landscaping and operational space. Since the gullies are irregular in shape it will probably be necessary to purchase the parcels of land which surround and contain the gullies. The depth of fill varies from one gully to another and from point to point within a gully. The volume that can be filled is determined by selecting a specific gully, laying out the final top surface contours and computing the volume between the original ground and the final cover.

The site illustrated in Figure 4-3 shows the necessary land which is approximately 282 acres. The principle gully on the site is shown filled to a top elevation of 990 ft., and can contain 4,000 acre feet. The auxiliary gully above and to the right is also filled to a top elevation of 990 ft. and can

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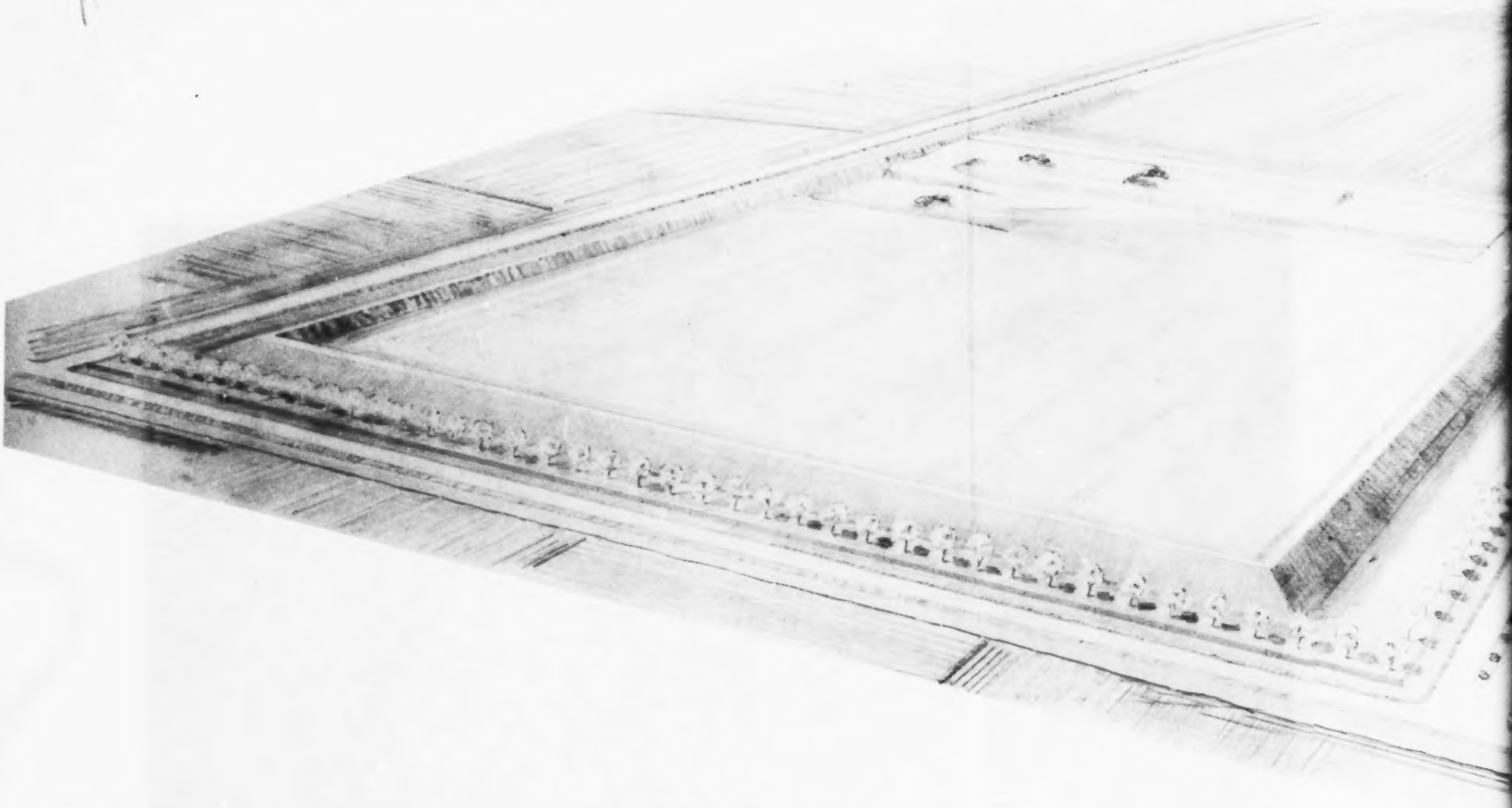
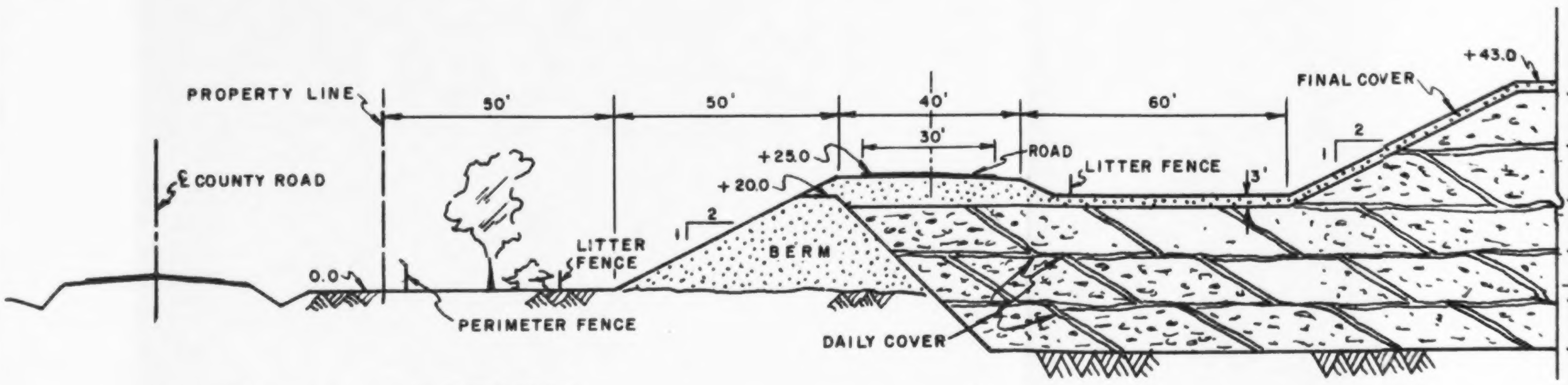


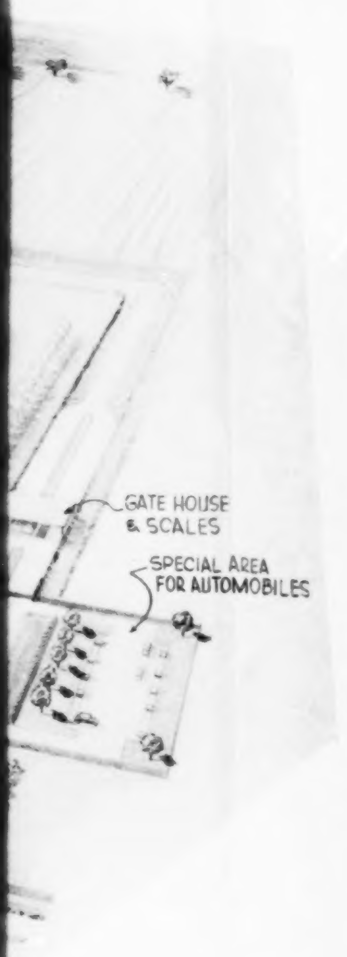
INITIAL DEVELOPMENT & 3 MONTHS OF OPERATION

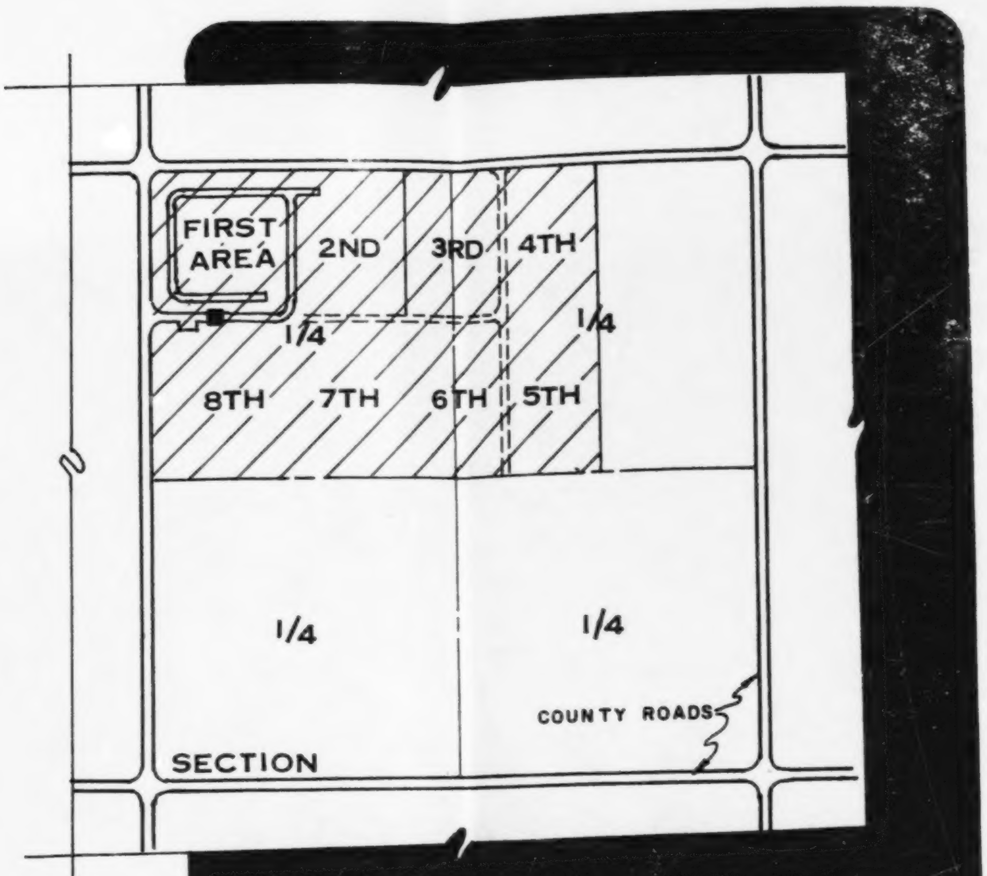

PROPERTY LINE
50'
50'
40'
30'
60'
+43.0
FINAL COVER
℄ COUNTY ROAD
+25.0
+20.0
ROAD
LITTER FENCE
3'
1
2
1
2
LITTER FENCE
BERM
0.0
PERIMETER FENCE
DAILY COVER

TYPICAL SECTION

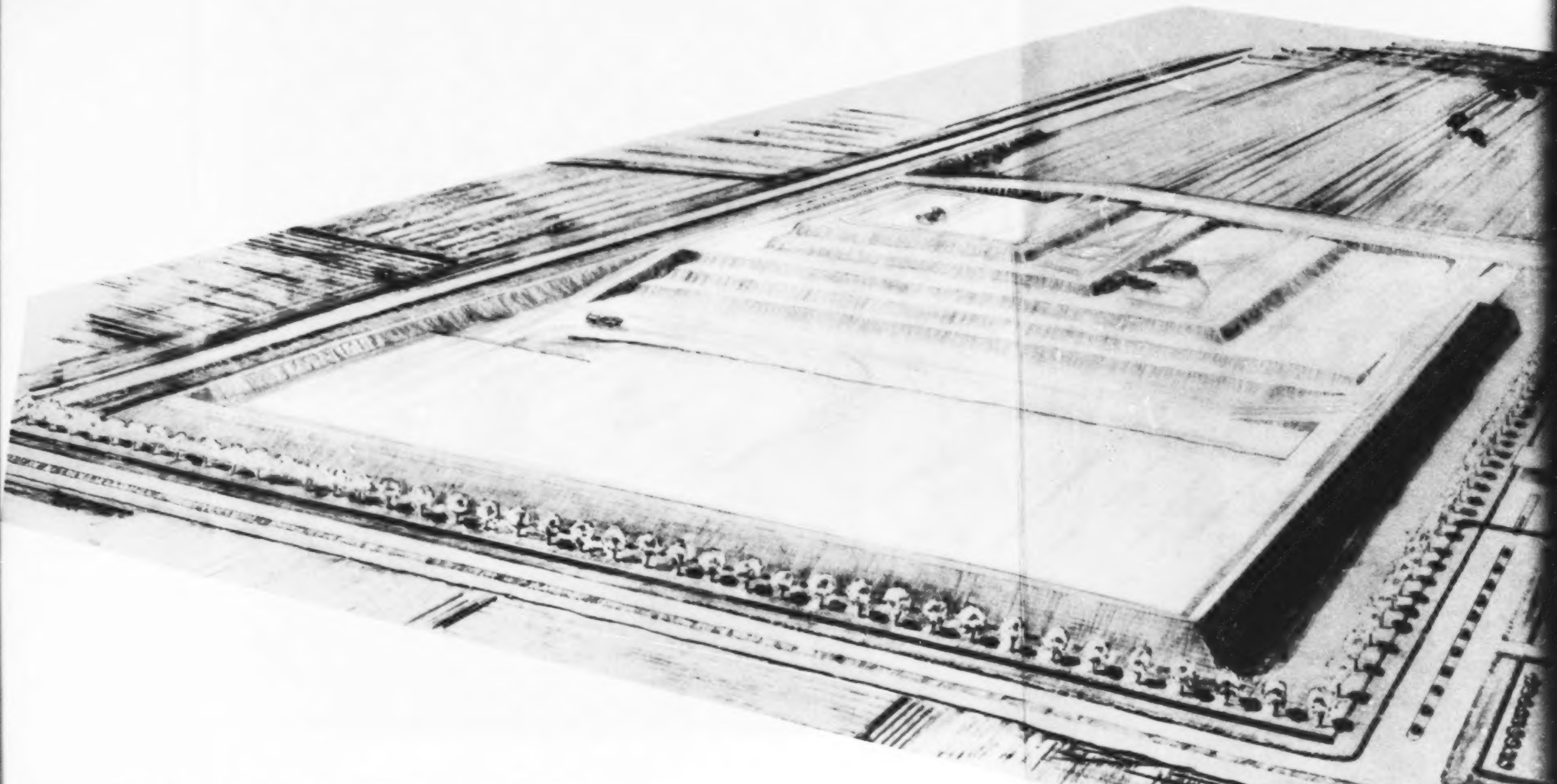
AFTER 1 Y

B

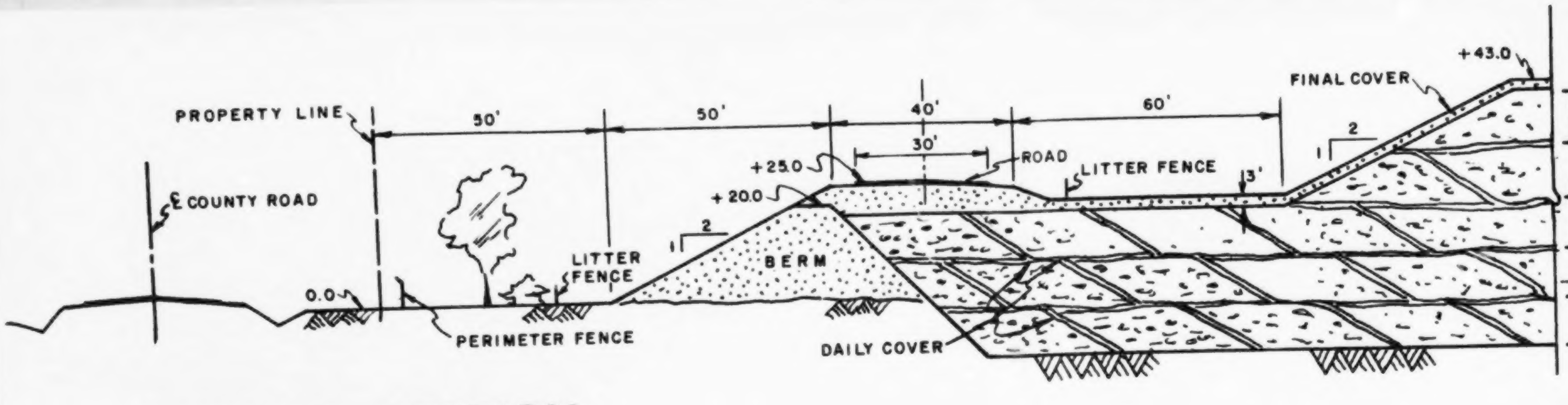

GATE HOUSE & SCALES
SPECIAL AREA FOR AUTOMOBILES


FIRST AREA
2ND
3RD
4TH
1/4
1/4
8TH
7TH
6TH
5TH
1/4
1/4
COUNTY ROADS
SECTION

POTENTIAL LAND USE



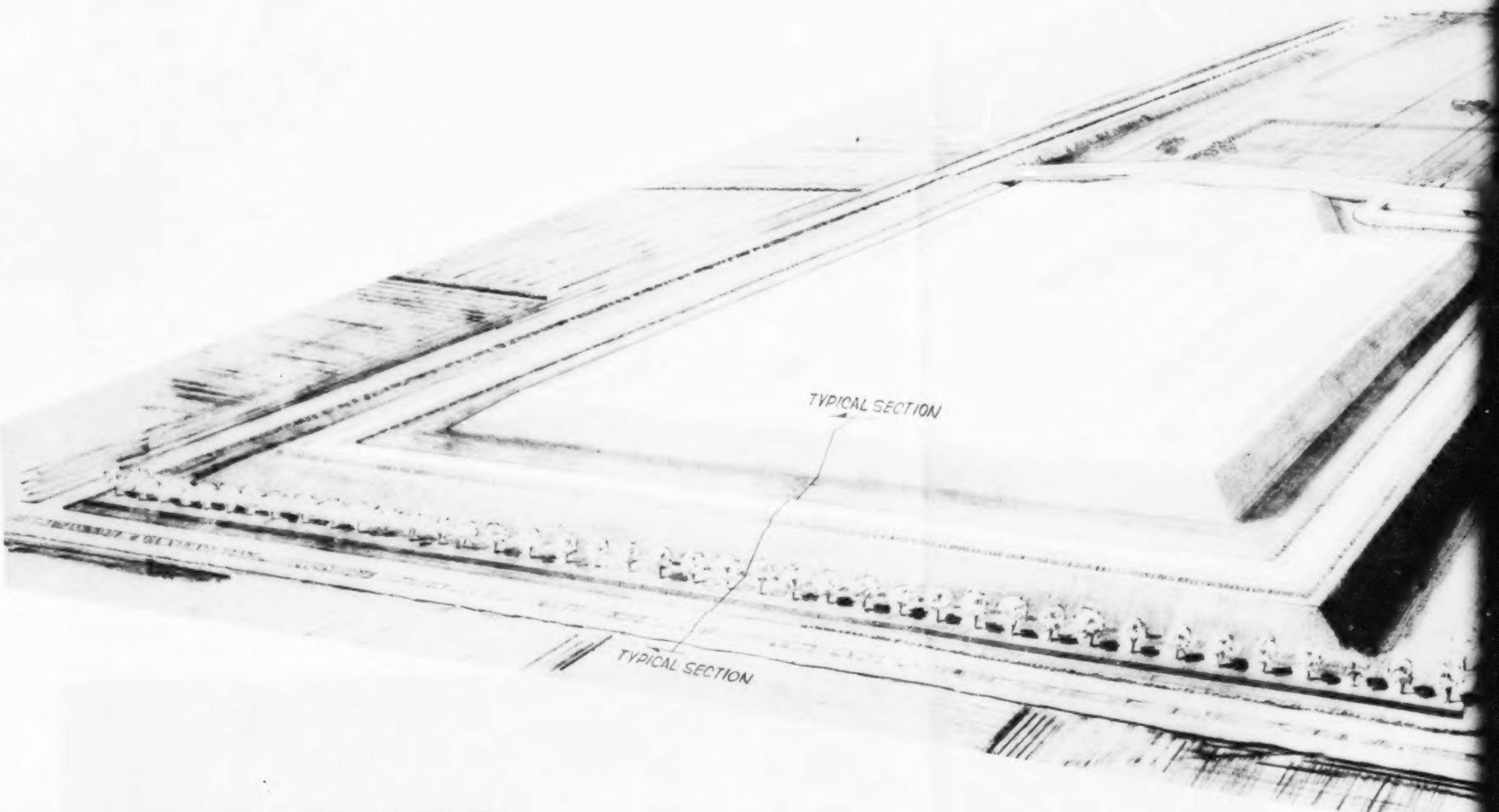
AR OF OPERATION


+43.0
FINAL COVER
+4
PROPERTY LINE
50'
50'
40'
30'
60'
2
1
+2
+25.0
+20.0
ROAD
LITTER FENCE
3'
+1
℄ COUNTY ROAD
2
1
+6
BERM
LITTER FENCE
0
-2
0.0
PERIMETER FENCE
DAILY COVER
-13

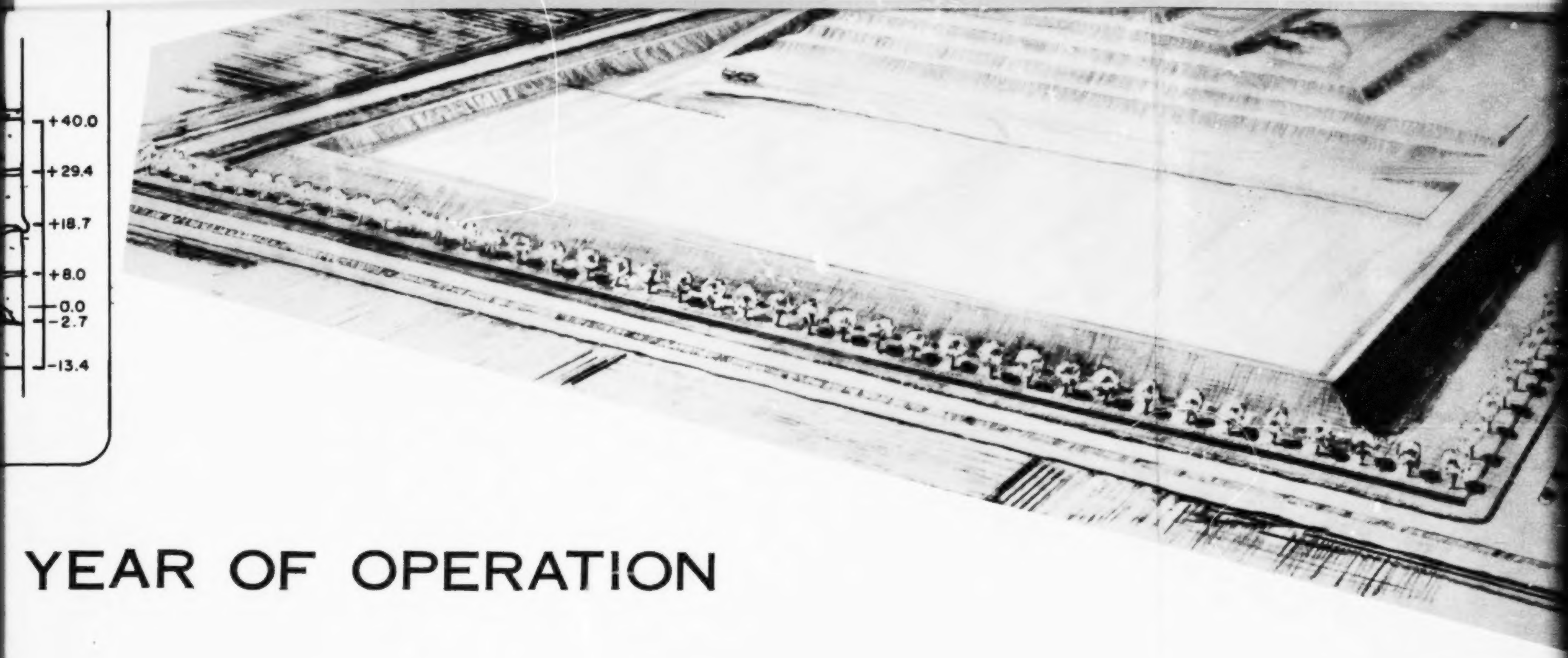
TYPICAL SECTION

C

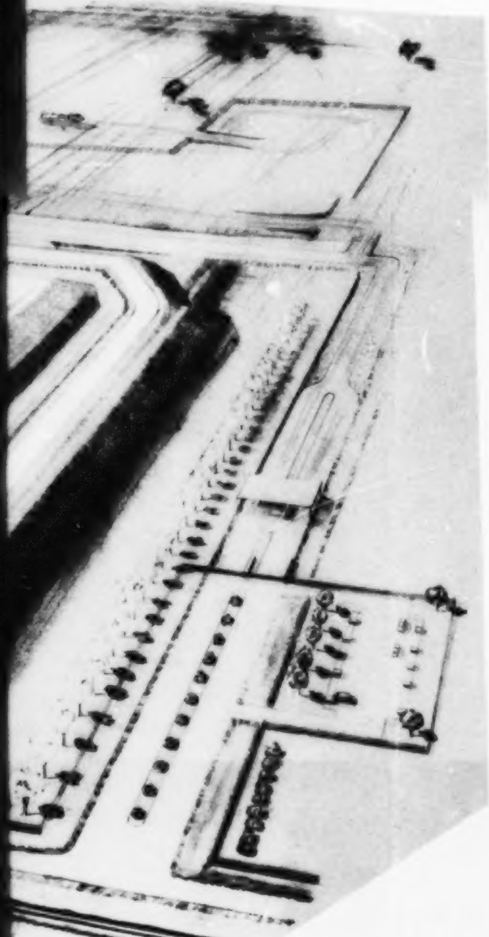
AFTER 1 Y


TYPICAL SECTION
TYPICAL SECTION

AFTER 3 YEARS
FIRST AREA IS FILLED

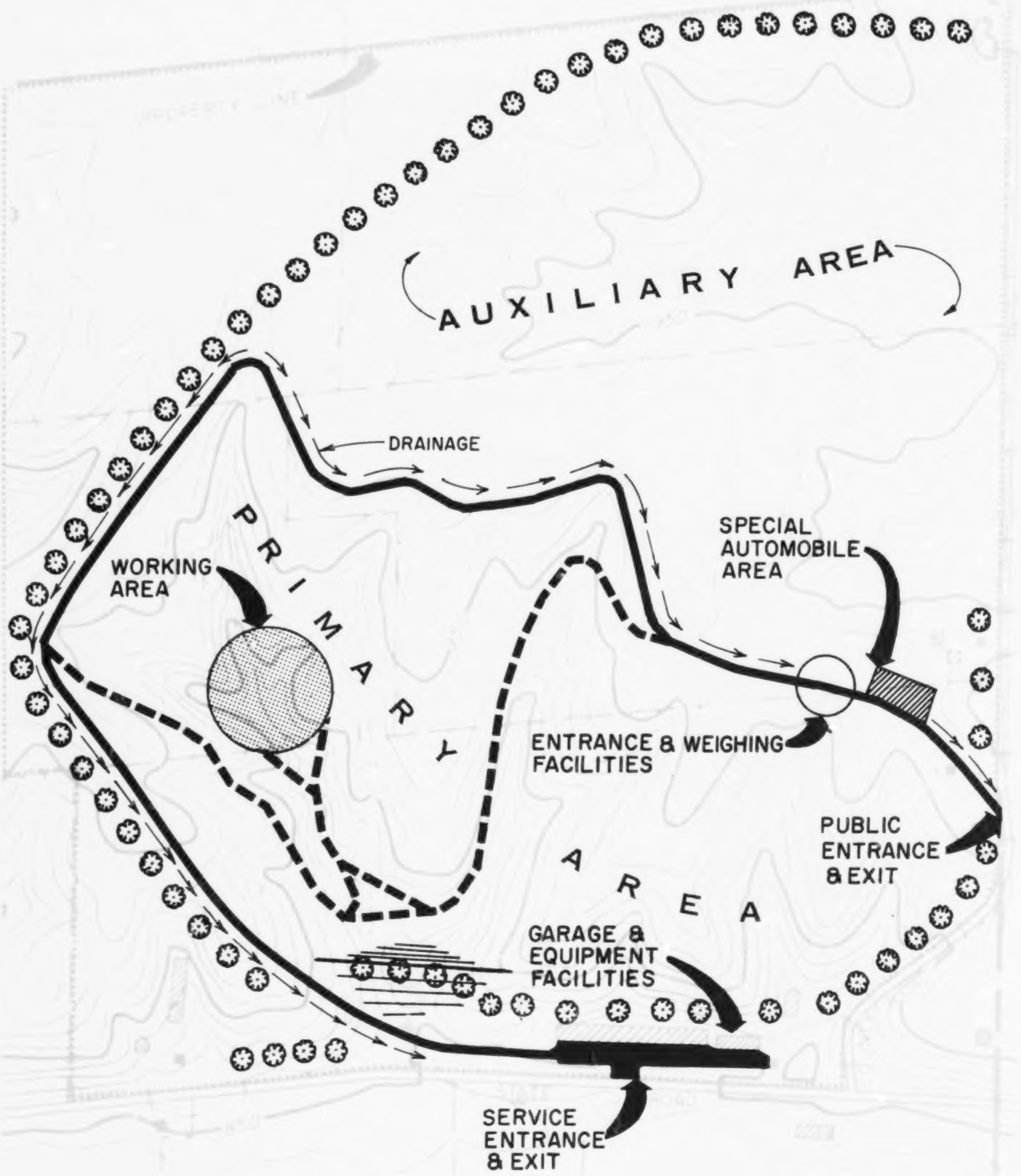

+40.0
+29.4
+18.7
+8.0
0.0
-2.7
-13.4

YEAR OF OPERATION



NORTHEAST SITE OPERATION

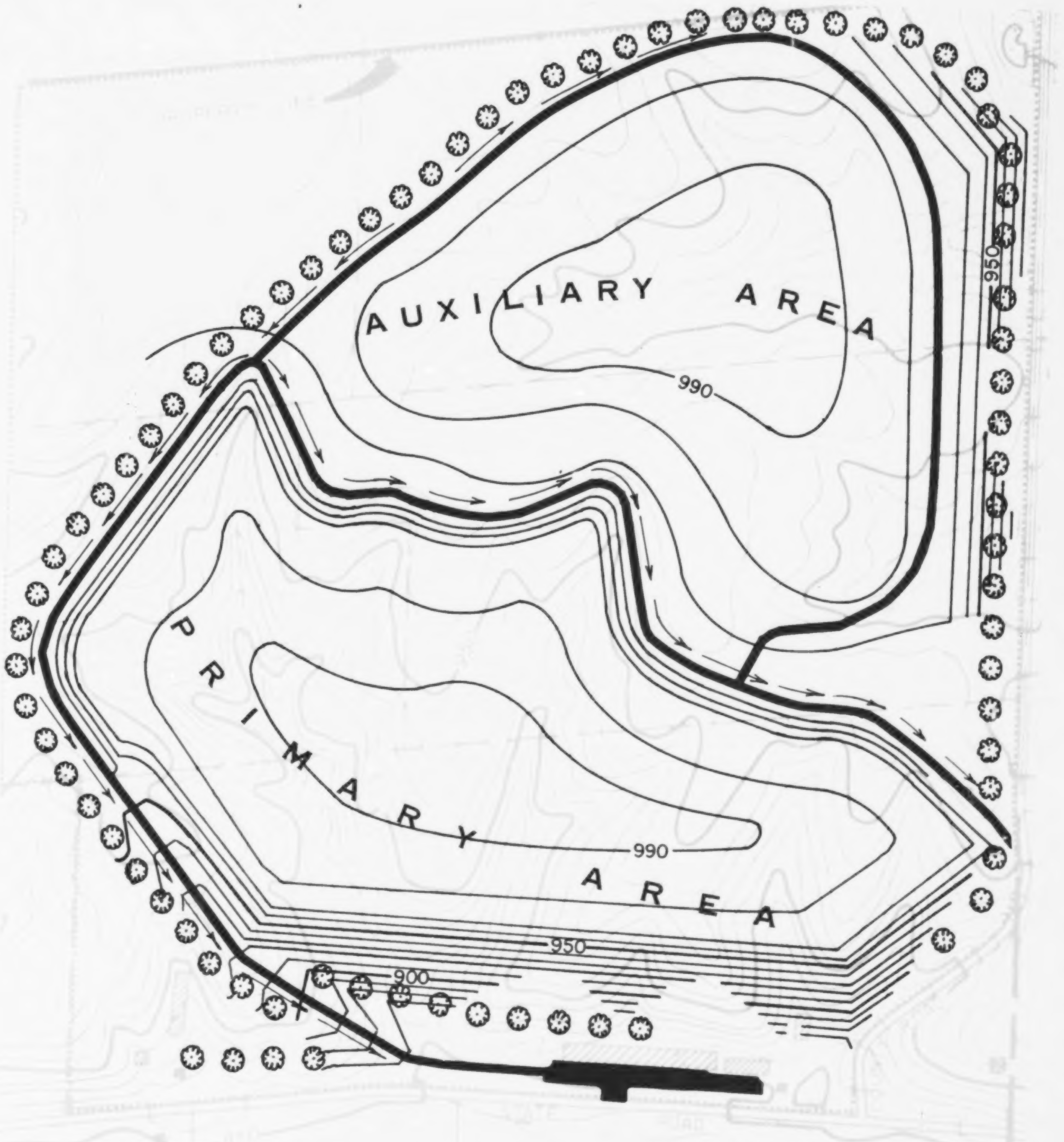
FIGURE


AUXILIARY AREA
PROPERTY LINE
DRAINAGE
PRIMARY AREA
WORKING AREA
SPECIAL AUTOMOBILE AREA
ENTRANCE & WEIGHING FACILITIES
PUBLIC ENTRANCE & EXIT
GARAGE & EQUIPMENT FACILITIES
STATE ROAD
SERVICE ENTRANCE & EXIT

INITIAL DEVELOPMENT

NORTH

SCALE 1"=500'


AUXILIARY AREA
990
950
PRIMARY AREA
990
950
900

FINAL DEVELOPMENT

SOUTHWEST
SANITARY LANDFILL SITE

FIGURE 4-3

contain an additional 2,000 acre feet.

3. Initial Development of the Site. Before any operation can commence, the site must be designed and developed. The procedure and items of work would be similar to that described for the site in the northeast area, except the details of the design would be completely different. The major site screening could be accomplished by landscaping. During the initial years while the landscaping was maturing, the operation would be hidden from view deep in the gully. An initial berm would be constructed across the lower end of the site and landscaped, but this berm would be limited in length and height.

Although the berm construction would be less than that shown for the northeast site, the temporary road construction would be more extensive. Roads would be required for access from the permanent perimeter road to the active face of the fill.

Details of the site development were not worked out to the extent shown for the northeast site. The costs were assumed to be similar and the same $200,000 estimate was used for initial development of this site.

4. Operation of the Site. The earth for cover can be taken from the bottom and side walls of the gully as the work progresses. The amount of cut must be calculated to cover the many lifts which will be made plus the final cover on top of the completed fill. The calculation must be based on the final design which will vary depending on which specific site is selected.

The great depth of fill in this type of site has a distinct advantage over a site filled to a 10 to 15 foot depth which is commonly used, due to a reduced volume of required final cover material. The final cover is recommended to be approximately 3 1/2 feet thick compared to a daily cover of approximately 8-inches thick. If a single lift were used it would require a final cover. If two lifts were used the final cover requirement would be cut in half. Similarly, each additional lift reduces the percentage of final cover per unit volume filled. This is also true for the five lift flat site proposed for the northeast area.

Filling should start at the upper end of the gully and be worked down some convenient distance. The second lift should be filled on the top of the first, and the third on top of the second in a manner similar to the filling of the flat site for the northeast area. Filling from the upper end of the gully allows surface water in the form of rain or snow to drain away from the fill. This is a very important feature which must be observed. When necessary, the filling can resume at the first level and be continued for another distance to give working and maneuvering room on the second and higher lifts. The process of extending the lowest lifts and then extending each higher lift should be repeated until the final contour or top of the completed fill is reached.

Once the principle gully is filled in, the operation can be moved to the auxiliary gully and started over again.

K. Sanitary Landfill Cost Estimates.

1. General. The itemized estimated cost for the two recommended sanitary landfills are presented in Table 4-4. The following paragraphs will discuss and, where necessary, explain each major line item presented for consideration. Estimated costs are based on current prices and wages. It will be necessary to refine these costs prior to actual implementation of the operations.

These estimated costs are based on each site being open for operation from 0800 to 1900 hours, 6 days per week, Holidays excepted. They are also based on filling the 1968 estimated quantities.

2. Basic Cost Data.

a. Land Costs. These costs were developed from the estimated land requirements for the two landfill sites, as explained in the preceding Sections I and J. Information from the County Assessor's Office and from real estate brokers and informal investigation of land prices for the selected general areas provided the estimated land costs.

b. Initial Site Development. These estimated costs were developed by analyzing the required physical developments for placing the northeast site in readiness for operation.

c. Annual Site Maintenance and Development. This estimated cost is the expected general maintenance necessary for the upkeep of the two sites and required annual expansion development.

d. Equipment Purchase. This estimated cost is for the equipment recommended for the operation of the two sites. The required equipment is itemized in the following line Item #5 and is a one-time expenditure for the initial procurement of equipment. The Agency may wish to lease existing equipment from a member community and use that equipment until it has been fully amortized. The funds included in this line item would be held until the equipment was amortized, and then used to purchase the initial replacement equipment which would not be leased but would be owned by the Agency.

e. Equipment Maintenance, Operation and Amortization Costs. These estimated costs are for the maintenance, operation (excluding labor) and amortization of the required equipment for the two sites. These costs are based on the following operating conditions:

(1) Each site works one bulldozer, 15 hrs. per day or 4,600 hrs. per year. Two dozers, plus one spare required, or 3,060 hrs. per year per dozer.

(2) One self-loading scraper, and one road grader, shared by both sites, 2,080 hours per unit per year.

(3) One tractor/mower, and one truck, shared by both sites.

Table 4-4

Cost Estimates For Sanitary Landfill Operations

Basic Cost Data

1.	Land Costs		
	Northeast Site: 240 acres @ $1,200/acre =	$288,000	
	Southwest Site: 282 acres @ $1,000/acre =	282,000	
	Total Estimated Land Costs		$570,000
2.	Initial Site Development (one site example)		
	Scale House	$ 30,000	
	Two Scales @ $9,000	18,000	
	Scale Equipment	10,000	
	Equipment Shed and Personnel Facilities	30,000	
	Watermains, 8" x 3000'	15,000	
	Perimeter Fencing, 10,000'	5,000	
	Entrance Fencing, 1000'	5,000	
	On Site Gravel Surfacing for Roads	18,000	
	Grading	35,000	
	Landscaping	14,000	
	Yard Lighting	5,000	
	Apron Pavement	5,000	
	Miscellaneous	10,000	
	Total Site Development Cost, One Site	$200,000	
	Total Site Development Cost, Two Sites		$400,000
3.	Annual Maintenance and Site Development 2 Sites @ $20,000 ea.		$ 40,000
4.	Equipment Purchase Cost of New Equipment (one time purchase only)		$240,000
5.	Equipment Maintenance, Operation and Amortization		

	hrs/yr. Each	hrs./yr. Total	Rate/hr.	Cost/yr.	
3 Bulldozers	3,060	9,180	$ 15.00	$137,700	
1 Scraper	2,080	2,080	10.00	20,800	
1 Grader	2,080	2,080	5.00	10,400	
1 Truck	1,040	1,040	4.00	4,160	
1 Tractor/mower	1,040	1,040	2.00	2,080	
2 Pick-up Trucks				2,000	
1 Misc. Equip.		2,080		5,000	
Total Equip. (2) Sites		17,500			$182,140

(Table continued next page)

Table 4-4 (Continued)

6. Labor

	hrs. /yr. Total	Rate/hr.	Cost/yr.	
Equipment Operators	17,500	$ 4.00	$ 70,000	
Laborers, 4 per site	8,320	3.40	28,300	
Foreman, 1 per site	4,160	4.25	17,700	
Gate Keeper/Fee Collector (16 man hrs. /day/site)	9,800	3.75	37,000	
Total Labor, (2) Sites	39,780			$153,000

7. Metro Agency Headquarters and Repair Shop

Office	$ 36,000	
Repair Shed	50,000	
Repair Equipment	60,000	
	$146,000	
50% Each for Collection and Disposal		73,000
8. Misc. Expense, Overhead and Contingency		100,000

Included in the equipment hourly rate for this line item is the estimated amortization of each piece of equipment. This amortization will in effect prepay the cost of replacement by establishing an equipment escrow fund to be used with trade-in equipment for necessary replacements.

f. Labor. These are the estimated costs for personnel to operate the required equipment and facilities of the two sites, exclusive of the management categories in the Metro Agency. Wage rates include benefit requirements.

g. Agency Headquarters and Repair Facilities. These costs are for the facilities and equipment necessary to operate the Agency's management and administration offices and repair shops for both the disposal and collection services. The actual estimated cost has been arbitrarily prorated on a basis of 50% for each service.

h. Miscellaneous Expense, Overhead and Contingencies. This is the estimated cost for miscellaneous expenses and contingencies, as well as general operating overhead for the Agency services, including wages for management and administration of the Agency.

3. Annual Costs, 2 Sanitary Landfills. The following annual cost calculations are based on the itemized requirements presented in Table 4-4, in which some expenditures are one-time initial development expenses and the remaining are annual reoccurring expenses. The one-time expenses are assumed to be financed through the sale of bonds, repayable at 4.5% interest over 20 years.

a. One-time expenses @ 4.5% x 20 years (.0768)

Land Costs	$ 570,000	
Initial Site Development	400,000	
Equipment Purchases	240,000	
Metro Headquarters & Shops	73,000	
Sub-Total	$1,283,000 @ .0768 =	$ 98,500

b. Reoccurring Annual Expenses

Site Maintenance & Development	$ 40,000	
Equipment M&O and Amortization	182,140	
Labor	153,000	
Misc., Overhead and Contingency	100,000	
Sub-Total		$475,140

c. Total Annual Costs for 2 Sites (Based on 1968 max. quantities) $573,640

4. Fixed and Variable Annual Costs. The following is a breakdown of cost into fixed and variable annual costs for the two sites, and will be used in the development of Unit and Total operation costs.

	Fixed Costs		Variable Costs	
Bond Amortization, one-time expenses	$ 98,500			
Annual Development			$ 40,000	
Equipment Costs	7,000		175,140	
Labor Costs	83,000		70,000	
Miscellaneous	50,000		50,000	
Totals	$238,500	+	$335,140	= $573,640

5. Quantity Calculations for Unit and Total Costs. The fol- calculations were established from information in Table 2-10, and will be used in developing the unit and total operation costs for the 2 sanitary landfill sites.

		Ac. Ft.	Tons
a.	1st year, 1968 quantities	717	655,000
b.	20th year, 1987 quantities	874	741,000
c.	Average year		
	1987 estimated accumulation	15,694	13,607,000
	Less 1967 estimated quantity	- 630	562,000
	1968 to 1987 accumulated	15,064	13,045,000
	Average year (÷ 20 years)	753	652,000

d. 1st year, 1968, reduced volume

When estimating the total tonnage for 1968, it was assumed that much of the on site disposal will be discontinued and sent to the public sanitary landfill sites. This assumption will be reasonably correct if extensive anti-air pollution and open burning ordinances are enacted and vigorously enforced.

With the exception of the Euclid Avenue private dump site and the Polk County landfill site, the public sites are operated free of charge to the users. Once a fee is charged, some of the material being delivered to these sites will be diverted to other disposal. This is particularly true of the inert materials, such as dirt, sand, rock and broken pavement, which can be used to fill low land in town without creating a nuisance. The extent of this diversion cannot be accurately predicted, but some provisions must be made to account for this material when predicting revenue requirements. It has been assumed that this diverted material and the amount of on site disposal which will temporarily continue as on site disposal will amount to 25% of the total. Therefore, for fee purposes, assume the material delivered to the sanitary landfill sites will be 75% of the estimated total.

1968 estimated quantity	717 ac. ft.	655,000 tons
1968 reduced quantity @ .75	538 ac. ft.	490,000 tons

6. Unit and Total Costs of Operation for 2 Sites. The following calculations establish unit and total costs of operation for the 2 sites.

Part of the cost of operation of the disposal facilities are fixed costs which do not vary with the amount of material disposed of. The remainder of the costs are directly proportional to the amount of material. Because of these fixed and variable costs, the unit cost of operation will vary with the amount of material.

a. First Year, 1968, 717 acre feet or 655,000 tons.

Fixed Costs	$238,500 ÷ 717 ac. ft. =	$333/ac. ft.
Variable Costs	$335,140 ÷ 717 ac. ft. =	$467/ac. ft.
Total	$573,640	$800/ac. ft.

$573,640 ÷ 655,000 tons = $.88/ton

b. First year, 1968, reduced quantity, 538 acre feet or 490,000 tons.

Fixed Costs	$238,500
Variable Costs 538 ac. ft. x $467	$251,246
	$489,746

$489,746 ÷ 538 ac. ft. = $910/ac. ft.
$489,746 ÷ 490,000 tons = $1.00/ton

c. Average year, 753 acre feet or 652,000 tons.

Fixed Costs	$238,500
Variable Costs 753 ac. ft. x $467	$351,700
	$590,200

$590,200 ÷ 753 ac. ft. = $784/ac. ft.; or $.49/CY
$590,200 ÷ 652,000 tons = $.91/ton

d. 20th year, 1987, 874 acre feet or 741,000 tons.

Fixed Costs	$238,500
Variable Costs 874 ac. ft. x $467	$408,200
	$646,700

$646,700 ÷ 874 ac. ft. = $740/ac. ft.
$646,700 ÷ 741,000 tons = $.87/ton

7. Bond Debt Service Reserve. Bond buyers insist the revenue be higher than the theoretical amount required to meet debt service payments. This extra revenue is known as debt service reserve or premium. In this estimate it is based on 40% of the debt service and is equal to .40 x $98,500, or $39,400. It is not actually a cost but is a necessary item in calculating revenue.

The debt service reserve is a fixed amount, but the unit cost of this reserve varies with the total tonnage as follows:

1st year, 1968, $39,400 ÷ 655,000 tons = $.06/ton
1st year, 1968, Reduced Volume, $39,400 ÷ 490,000 tons = $.08/ton
Average year, $39,400 ÷ 652,000 tons = $.06/ton
20th year, 1987, $39,400 ÷ 741,000 tons = $.05/ton

8. Summation of Unit Costs and Required Revenue

	Operation Cost $/Ton		Debt Service Reserve Cost $/Ton		Total Unit Cost $/Ton
(1) 1968	$ .88	+	$.06	=	$ .94
(2) 1968, Reduced Volume	$1.00	+	$.08	=	$1.08
(3) Average Year	$ .91	+	$.06	=	$ .97
(4) 1987	$ .87	+	$.05	=	$ .92

L. Rates for Recommended Disposal Fees. The disposal fee recommended for financing purposes, is based on $1.08 per ton which is the highest unit cost established in the preceding calculations. This unit cost does not represent the highest dollar requirement because it is based on reduced tonnage. If the reduced tonnage is realized, the dollar requirement will be adequate. If the actual tonnage received proves to be higher than the amount used to calculate the unit cost, the total dollar requirement will be greater than that which is predicted. In this case, the increased tonnage will produce more than enough revenue to pay the cost of disposing the additional material, since the unit cost was based on the more expensive operation, due to the reduced tonnage situation.

We recommend the disposal fee rate be set at $1.10 per ton, with a $.75 minimum disposal charge.

M. Use of Completed Sanitary Landfill Sites. Once completely filled, sanitary landfill sites can be used for a variety of purposes. It is necessary, however to understand the nature of a fill site when planning other uses. The sites will settle over a period of time therefore improvements built upon solid waste fills must be either compatible with settlement or the foundations must penetrate the fill into firm ground below the fill. Many successful structures have been built on fills using light buildings and floating foundations. Also many heavy structures have been built on piles penetrating through the fill.

The sites will produce some gasses, normally methane, due to the biological decomposition of the organic material in the fill. These gasses are toxic and explosive when confined under the proper conditions. Many successful structures and other improvements have been constructed where the gas problem has been properly handled.

Generally completed landfills have been used for open space purposes such as parks and recreation areas.

Normal improvements associated with these uses such as pavements, shelter houses, etc. can be designed for landfills.

The amount of settlement and the amount of gas produced, and the time functions of each vary with many factors. The density of the fill, the type and quantity of cover material, moisture, total depth of fill, materials in the fill, and others all play a role. For rough planning purposes it can be assumed that a fill will settle approximately 20% over a period of several years.

In the case of the Northeast site where the total depth of filled material is 50 feet, the first lift will probably be reduced to 80% of its former depth by the time the top lift is placed due to the weight of the superimposed upper lifts. Additional settlement will take place slowly due to the great depth and lack of moisture from the top. (assuming of course there is no contact with ground water). Each additional lift will also be consolidated by the lift above except for the top lift which will only receive a final cover of 3 feet of earth.

The elevations of the five lifts shown in Paragraph I, 4 are simplified for illustration.

The settlement of the lower lifts will change the actual elevations to some extent. Part of the settlement is anticipated in the fact that 63.4 feet of material (50 feet of waste and 13.4 feet of dirt) is placed in 56.4 feet of depth (-13.4 to +43.0) except for the material used for berms and roads. The actual final elevation at the time of placing the final cover would probably be less than 43.0 feet. This elevation within a period of years could be expected to drop several more feet.

Planners in the community are cautioned to take special notice of the rate of completion of finished filled land. When a landfill is conducted using only one or two lifts the rate of completion of filled land is many times greater than the landfills contemplated in this report, where many lifts are contemplated. They may wish to concentrate efforts on the land not being filled for the first 10 years, and then devote their efforts toward use of completed portions.

In the case of the Southwest site the Primary Area shown in Figure 4-3 will be worked for years before completion; however at the same time the Auxiliary Area will remain idle and could be placed into some interim use.

At both sites the unused land could be leased for agricultural purposes until needed for filling.

PART FIVE - THE METROPOLITAN SOLID WASTE AGENCY

A. General. The formation of a single municipal type organization, responsible for the collection and disposal of all solid waste generated within the Des Moines Metropolitan Area has been proposed in previous sections of this report. A summary of the advantages to the total community in the operation of such an organization are as follows:

1. Adequate and uniform collection service provided throughout the area at the most economical costs.
2. More efficient use of manpower and equipment due to consolidation of collection routes on an area basis rather than following city limits.
3. The smaller communities will enjoy collection and disposal services at a unit cost comparable to the larger cities.
4. Concentration of all disposal operations in a few economical and properly located and operated sites; rather than many expensive and poorly run sites scattered throughout the area.
5. Relieve local authorities of the administrative and operational problems of running collection and disposal departments.

The collection and disposal of solid waste is not the single problem of any one city, town or county in the area. Sanitation problems, ground water contamination, air pollution, and wasteful uses of land, result from improper solid waste practices. As the population continues to increase, the need for professionally managed collection and disposal facilities will become more acute. It is proposed that the establishment of a Metropolitan Solid Waste Agency appears to be the most efficient and practical approach to this problem.

B. Legal Basis. Legal authority for the establishment of such an Agency presently exists under the provision of Chapter 28E, Code of Iowa, 1966. This Chapter passed by the 61st General Assembly of Iowa in 1965, provides in part that units of Federal, State or local government, may exercise jointly any powers, privileges or authority, that they are authorized to exercise independently. This statute is commonly referred to as the Intergovernmental Cooperation Act.

Included in Appendix Exhibit 5-1, is a proposed form of an intergovernmental agreement applicable to all cities, towns and counties in the Study Area. Adoption of this agreement by two or more (preferably all) of the governing bodies within the area is the first step toward the comprehensive area wide approach to the handling of solid waste. The agreement has been prepared in accordance with the provisions of Chapter 28E, and has been reviewed and approved by local municipal legal authorities.

C. Formation of the Agency. It is recommended that the Agency be established as an independent entity, governed by a policy making Board, comprised of elected representatives of each member city, town or county. Each member jurisdiction would have one representative on the Board, and each representative would have one vote for each 50,000 of population or fraction thereof, residing in the area he represents. Establishment of the Board on this basis would have the following advantages:

1. The Board would function with real authority since individual members would represent and speak directly for their respective city and town councils, and county boards of supervisors.

2. Feedback to the member jurisdictions would be accomplished by having direct representation on the Board.

3. Limiting each jurisdiction to one member on the Board would prevent the membership of the Board from becoming too large to function effectively as a policy making body.

4. Weighting the vote of each member on a population basis would provide a fair method of recognizing the population differences between the member jurisdictions.

The length of the term of membership on the Board should be determined when the By-Laws for the Board are initially drawn up. Provisions should be made to assure continuity on the Board, taking into account the variations in the ordinances of the member jurisdictions regarding length of office of elected officials.

The broad purposes of the Agency as outlined in the proposed "Articles of Agreement" are as follows:

1. To provide for the efficient and economical, collection and disposal of all solid waste produced or generated within the metropolitan area of Des Moines.

2. To promote through good practice, effective means for reducing or preventing the contamination and pollution of the land, water and air resources of the metropolitan area.

3. To provide for a self-supporting, independent organization, equipped with sufficient manpower and facilities to adequately perform Items 1 and 2.

PROPOSED ORGANIZATIONAL STRUCTURE FOR AGENCY

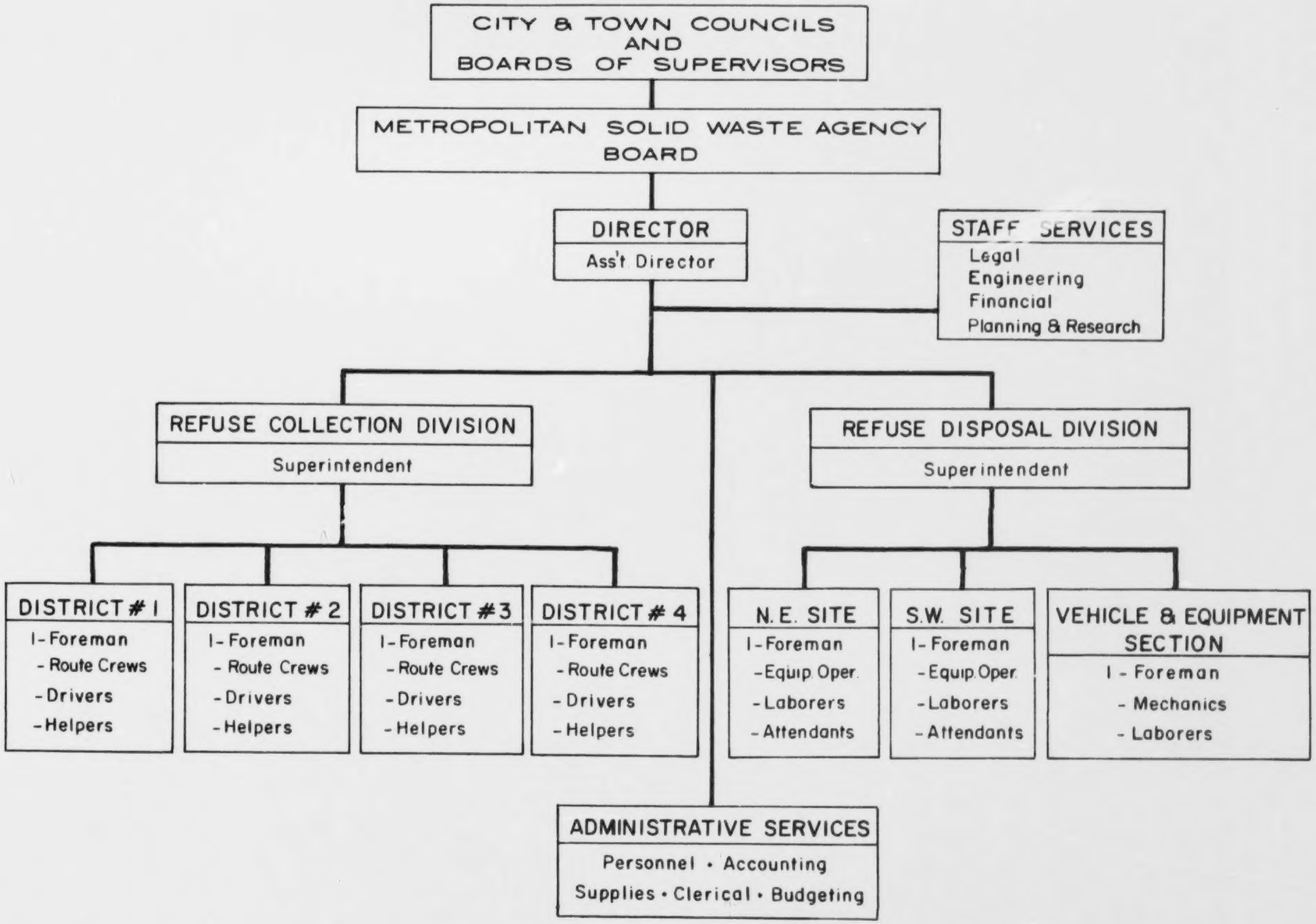

CITY & TOWN COUNCILS AND BOARDS OF SUPERVISORS
METROPOLITAN SOLID WASTE AGENCY BOARD
DIRECTOR
Ass't Director
STAFF SERVICES
Legal
Engineering
Financial
Planning & Research
REFUSE COLLECTION DIVISION
Superintendent
REFUSE DISPOSAL DIVISION
Superintendent
DISTRICT # 1
1-Foreman
-Route Crews
-Drivers
-Helpers
DISTRICT # 2
1-Foreman
-Route Crews
-Drivers
-Helpers
DISTRICT #3
1-Foreman
-Route Crews
-Drivers
-Helpers
DISTRICT # 4
1-Foreman
-Route Crews
-Drivers
-Helpers
N.E. SITE
1-Foreman
-Equip. Oper.
-Laborers
-Attendants
S.W. SITE
1-Foreman
-Equip. Oper.
-Laborers
-Attendants
VEHICLE & EQUIPMENT SECTION
1 - Foreman
- Mechanics
- Laborers
ADMINISTRATIVE SERVICES
Personnel • Accounting
Supplies • Clerical • Budgeting

FIGURE 5-1

A proposed organizational structure for the Agency is shown on Figure 5-1. This chart indicates the flow of authority from the elected municipal and county officials, to the Agency Board and the director. The operations of the Agency would be divided into three main functions, as shown on the chart; refuse collection, refuse disposal and administrative services.

The director would be responsible for the administration and operation of the Agency, under policies set up and adopted by the Board. This is a top level position requiring experience in public works management, engineering and public financing.

The assistant director shall have qualifications similar to that of the director. The superintendents in charge of collection and disposal should have public works backgrounds or considerable experience in refuse collection and disposal or similar qualifying experience.

Professional staff services such as legal, engineering, planning and research could be provided by full time employees or by consultants. This determination should be made by the Board and the director in the development of the work program for the Agency. Possibly the Agency may be able to utilize personnel employed by member communities for these specialized services.

It is believed that the majority of jobs in the collection and disposal divisions can be filled by absorbing qualified personnel from existing municipal refuse agencies.

In-service training programs should be established, particularly in the refuse disposal division, to adequately train personnel at the two landfill sites in the methods and procedures recommended in Part Four of this report.

In addition, provisions should be made to guarantee that transferring employees retain their basic job benefits, including seniority, vacation accruals and retirement credits.

D. Operation of the Agency. It is proposed that the Agency be operated in a manner similar to a public utility, responsible to the Agency Board rather than any one municipality or county. It should have authority to operate independently of city limits or county lines provided the city or county is an Agency member.

The Agency will be able to function most efficiently and economically if all 14 governmental jurisdictions in the metropolitan area are participating members. However, this is not an absolute necessity. It is possible, economically, for any two of the communities to form the Agency, although the effect of this would be to leave many of the area problems unsolved.

Basically, the Agency will provide two types of service for the area; refuse disposal and refuse collection, as follows:

1. Refuse disposal - Two Agency owned or leased, managed and operated landfill sites will be open to anyone wishing to dispose of solid waste. The description and location and operation of the landfill sites have previously been discussed in Part Four. Each vehicle other than automobiles will be charged a disposal fee, based upon the weight of the refuse.

It is recommended that private individuals using automobiles be allowed to use the landfill sites without charge. A proposed disposal ordinance has been prepared and is included in Appendix Exhibit 5-2.

2. Refuse Collection - The Agency will contract with each member jurisdiction to provide refuse collection service. The contract will include the method of determining the actual cost, the type of service, frequency of service and other related items. It is recommended that each member jurisdiction adopt a refuse collection ordinance, consistent with collection requirements of the Agency. A proposed collection ordinance has been prepared and is included in Appendix Exhibit 5-3. The description of the recommended refuse collection service is described in Part Three.

Initially, a problem will exist in providing collection service in the unincorporated areas of the counties. Statutory authority for county refuse collection is presently not available. It is recommended that county officials request such legislation during the 1969 session of the legislature. Until such legislation is available, it is believed that collection service can be provided to most unincorporated areas on a voluntary basis.

E. Financing

1. Revenue Bonds. Initial capital investments and annual operating revenue will be required for both collection and disposal service. It is recommended that the initial capital investments be financed through revenue bonds. The required annual operating revenue and debt service on the bonds can be raised from fees charged by the Agency for collection and disposal services rendered to the member communities.

The details of the financing should be worked out by financial consultants at the proper time. In this section, the revenue requirements and the fees necessary to meet these requirements are summarized.

Bond authorities informally doubt that the Agency, created under the provisions of Chapter 28E, Code of Iowa 1966, would have the specific authority to issue bonds of any kind. Apparently this matter has not been necessary to date nor tested in any court. It would be beneficial if this authority were added to the provisions of Chapter 28E. Without such specific authority, potential bond buyers might be reluctant to purchase the bonds. As an alternative it has been suggested that a declaratory judgment be requested from an appropriate court stating that the authority to issue bonds is implied in the language of the Chapter and that an agency organized under the Chapter has such authority. The decision on this matter should be made by competent legal counsel. In any case, specific legislation should be requested granting this authority to the Agency.

In the event the Agency cannot issue revenue bonds in the name of the Agency, it is recommended that one of the member municipalities issue the bonds under its own authority. The capital investments made with the bond proceeds would be held in the name of the municipality, at least until the bonds were paid. Meanwhile, land, improvements and equipment purchased with the bond proceeds would be leased to the Agency. The lease agreement and a pledge of the required funds from fees would be used as security to back the revenue bonds.

Revenue bonds do not effect the general bonding power of the municipality. They are not included in statutory debt limits nor are they an obligation of the municipality. Revenue bonds are secured only by the revenue produced by the activity for which they were issued.

Whether the Agency has the right of eminent domain is a question similar to that concerning the authority to issue revenue bonds. If it is determined the Agency does not have such power, then the municipality issuing the revenue bonds should also exercise its right of eminent domain to acquire any land needed for Agency activities. Authority does exist for the Agency to acquire land and buildings by negotiation and purchase.

2. Revenue Required. The amount of revenue required for annual operating expense and debt service is summarized in Table 5-1.

The cost estimates from which this table was prepared are explained in Parts Three and Four.

A total bond issue in the amount of $1,727,000 is the amount of one time capital investment anticipated. The total revenue requirement, including debt service, debt service reserve and annual expenses is estimated to be $1,374,846 per year.

3. Income

a. General. It will be necessary to provide income which is equal to the required revenue shown in Table 5-1.

It is recommended that the collection system and the disposal system be considered as separate operations and that income for each be adequate to produce the revenue required for its operation.

Table 5-1

Revenue Requirements and Income for Agency Collection and Disposal of Solid Waste

A. REVENUE REQUIREMENTS

				Annual
1.	Collection			
	a.	Bond Debt Service $444,000 x .0768		$ 34,100
	b.	Annual Operating Expense		786,000
		Total Cost, Collection Service		$ 820,100
	c.	Debt Service Reserve $34,100 x .40		13,600
		Total Collection Revenue Required		$ 833,700
2.	Disposal			
	a.	Bond Debt Service $1,283,000 x .0768		$ 98,500
	b.	Annual Operating Expense (Includes disposal Cost of Agency Collected Refuse)		391,246
		Total Cost Disposal Service		$ 489,746
	c.	Debt Service Reserve $98,500 x .40		39,400
		Total Disposal Revenue Required		$ 529,106
3.	Summary of Revenue Requirements			
	a.	Total Bonds		$1,727,000
	b.	Total Debt Service	$ 132,600	
	c.	Total Annual Operating Exp.	1,177,246	
	d.	Total Debt Service Reserve	53,000	
	Total Revenue Required for Collection and Disposal			$1,362,846

Note: Bonds 20 yrs. 4 1/2%, (.0768)

B. INCOME

1.	Total Collection Fees		
	87,300 dwelling units @ 10.80/yr.	$ 943,000	
	Less disposal cost included in collection fees. (66,600 tons @ 1.10/ton)	- 73,300	
	Net Collection Revenue		869,700
2.	Net Disposal Fees (Includes disposal fees for collected refuse) 490,000 tons @ $1.10/ton		539,000
	NET INCOME TO AGENCY		$1,408,700

b. Disposal Fees. The disposal operation should be completely self-supporting by charging fees from the users of the facilities. Several systems for charging of fees are possible. These are explained in the Appendix in Exhibit 5-4. The recommended system is based on the weight of material brought to the site in each vehicle.

In Part Four - Disposal of Solid Waste, the cost of disposal has been determined for several conditions involving various quantities of waste material. The unit costs for the several conditions, and the total cost of operation based on the quantities and appropriate unit costs are included. The highest unit cost, which must be used to set fees, is $1.08 per ton based on 490,000 tons per year. It is recommended that a fee be set equal to $1.10 per ton which will produce an income of $539,000/year.

c. Collection Fee. The collection system should be completely self-supporting by charging member municipalities a fee for the collection service provided. This fee would be based on the number of dwelling units within the municipality receiving collection service. The source of funds from which the municipality would pay the Agency would be from either budgeted amounts raised through a regular tax levy, or from fees charged by the municipality to the dwellings receiving this service. In the event a municipality would elect to charge fees they could arrange with the Agency to bill the dwellings directly for and on behalf of the municipality. The cost of this billing could be included in a slightly higher fee or paid by the municipality.

In Table 5-1, the required revenue for collection is shown as $833,700. The revenue required to dispose of the collected refuse is $73,300, for a total revenue requirement of $907,000. This figure represents the revenue that must be collected in fees from the users of the collection service. Based upon a population of 288,000 and an average figure for the Study Area of 3.2 people per dwelling unit, the unit cost is equal to $3.15 per capita per year or $10.08 per dwelling unit per year. It is recommended that a fee be charged equal to $0.90 per month per dwelling unit. This would result in an annual cost of $10.80 per dwelling unit.

F. Interim Activities. While the Agency is being formed an interim director should be appointed to guide the formation of the Agency, the preliminary work on financing and legislative problems, and the selection and hiring of a qualified permanent director. It would be desirable if the permanent director could be hired and the Agency brought into being within a few months.

The Agency has many activities which must be accomplished prior to starting collection or disposal of solid waste. Once the director is hired the following items should be accomplished:

1. Review the report recommendations and prepare a detailed statement of policy. There are several recommendations which the member municipalities may wish to modify and several which are stated in general terms, which must be defined in light of the particular needs of the members.

2. Review the report and make adjustments where necessary after it has been determined which municipalities have agreed to join the Agency.

3. With the aid of fiscal and legal consultants prepare the financing and legislative procedures, and pursue these matters at the proper time.

4. Conduct sanitary landfill site investigations and select the specific parcels of land to purchase.

5. Design the initial development of the sites which have been selected.

6. Assist the member communities in the interim improvements in their collection and disposal practice.

7. Arrange lease agreements with those members who have equipment which will be leased to the Agency.

8. Determine the total equipment needs of the Agency as formed. These needs will include leased equipment and new equipment. Prepare cost estimates for the purchase of equipment not being leased and cost estimates and schedules for initial purchase of equipment as leased equipment is replaced with Agency owned equipment.

9. Plan for the staffing of the Agency with regard for the employees now working in collection and disposal divisions in the member communities, and the recruitment and hiring of new personnel.

10. Prepare standard operating procedures, job descriptions, operating instructions and policies of the Agency which are pertinent to the operation of the collection and disposal services.

11. Plan the new collection routes as required to meet the exact needs of the Agency.

12. Determine the new revenue requirements and projected income based on actual conditions which will prevail at the time of operation.

13. Prepare all of the details for the orderly commencement of operation.

14. Sell the revenue bonds, purchase the land and equipment, construct the necessary improvements, acquire the personnel.

15. Place the Agency into operation.

Part of the interim activities will require the assistance of specialists and consultants. Where there are member municipalities which have the required specialists on their staff and their duties will permit, these staff members may be used to advantage. It will probably be necessary to hire bond consultants in connection with the issuance of revenue bonds and engineering consultants to assist in the details of site selection and initial site development.

To finance the interim activities, it is recommended that an initial budget based upon per capita membership be paid to the Agency by the joining members.

This budget should include funds for the support of the director and his staff, required consultants and the initial operating funds for the collection and disposal activities.

G. Alternate Collection by Contract. A municipal type collection system has inherent cost advantages over a system operated by a private contractor. These cost advantages are due to the fact that the municipal system does not pay taxes and does not earn a profit. Nevertheless, a private contractor can compete with a municipal system if the latter does not manage an efficient system.

To insure that the Agency collection system is operated in an efficient and economical manner, the Agency should take bids from private contractors after a period of approximately three years. The Agency's cost record should be its bid. If a contractor is willing to provide the same service at a cost which is less than the established cost record of the Agency, then a contract should be awarded. Bids should be taken on carefully prepared specifications, setting forth all of the conditions for operation, equipment, and other items to completely describe the service to be rendered. The time of contract should be for 5 years or longer.

We do not recommend taking bids for the first few years. There are potential savings to be enjoyed and the Agency, if properly managed, should be able to operate in a manner to provide adequate and economical service.

H. FEDERAL PARTICIPATION

The preparation of this study and report was financially assisted by a Federal Grant from the Solid Waste Program, USPHS, Department of Health, Education and Welfare. This grant representing 2/3 of the total cost of the study, was authorized under the provisions of Title II of Public Law 89-272, known as the Solid Waste Disposal Act.

This Act, in addition to financing studies of this type, also has grant provisions for the construction of new or unique solid waste facilities; and research projects and analysis directed toward improved or new methods in collection and disposal practices.

A major amendment to this Act was proposed in both Houses of Congress in 1967, but not acted upon. It is quite likely that this amendment will be considered sometime during 1968. If adopted this amendment would provide up to 75% of the cost, for metropolitan areas, of constructing solid waste disposal facilities, including completion and improvement of existing facilities.

Passage of this amendment should be carefully watched by the Agency Board and the director. A sizeable grant toward constructing and equiping the landfill sites would reduce considerably the size of the revenue bond issue required for the Agency's initial operation. This would, in turn, also reduce the disposal fees that would be required.

It is not suggested that any of the improvements or recommendations made in this report be delayed pending the possibility of additional Federal Funds. It has been demonstrated that these improvements can be made and service improved at a reasonable cost to the community. However, any additional method of reducing these costs should not be overlooked as they might become available.

APPENDIX

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HENNINGSON, DURHAM & RICHARDSON
VEENSTRA & KIMM

Re: METROPOLITAN DES MOINES
SOLID WASTE STUDY #3170106

ADDRESS REPLY TO:
November 1, 1967

U. S. Public Health Service
Solid Waste Program
222 East Central Parkway
Cincinnati, Ohio 45202

Attention: Mr. John Ruf, Project Officer

Dear Mr. Ruf:

You indicated some concern about the fact we were estimating the additional amount of solid waste we would receive from domestic sources when, and if, the Metro Area converted from their present practice of collecting only domestic kitchen solid waste to collecting all domestic solid waste.

We explained that it was extremely difficult to collect good data due to the confused route situation as it exists today, and the fact that the magnitude of the amount of material to be estimated was indeed small considering the total amount of solid waste of the community.

We could not give you facts and figures concerning the exact amounts because our very extensive data was not out of the computers. We now have the first run and I can give you preliminary figures which indicate the magnitude of the quantities. These are compared to Omaha and Dubuque quantities which represent communities not unlike Des Moines.

In Omaha, with a population of approximately 360,000 people, approximately 7,200 CY per week of refuse is collected. This collection is made once a week and includes all domestic solid waste.

In Dubuque, with a population of 61,200 people, approximately 1,435 CY per week of refuse is collected. This collection is made twice a week and includes all domestic solid waste. If twice a week collection accounts for 1:20 times the once a week collection, they would have 1,435 + 1.20 or 1,195 CY per week on a once a week basis.

The average for once a week collection for Omaha and Dubuque is .0199CY/cap/week.

EXHIBIT 2-1

7,200 ÷ 360,000 = .020
1,119 ÷ 61,200 = .0195
8,395 421,200 = .0199

In Des Moines the land fill surveillances indicated that they were collecting 2,472 CY/ week. This collection is on a once a week basis and officially includes only domestic kitchen waste. On a per capita basis this amounts to .0117 cu. yds. per capita per week (2,472 ÷ 210,000)

On the basis of the average of Omaha and Dubuque at .0199 CY per cap/week and a population of 210,000 people, Des Moines would be collecting approximately 4,100 CY/week if collecting all domestic solid waste. Since they are now collecting 2,472 CY the additional amount to be collected should be approximately 1,628, an additional 40%.

We know that the citizens include more than just kitchen waste in their waste containers and we know that the collection crews will collect more than just kitchen waste from many of the citizens.

The population of Des Moines is approximately 3/4 of the population of the study area. If the Des Moines rate of 2,472 CY per week was increased to represent the total study population this rate would become 3,330 cu. yds. per week (2,472 x 4/3).

The total study area solid waste measured at the time of the surveillance, on an as received basis, was 47,346 CY per week. The domestic solid waste represents only 7.0% of the total (3,330 ÷ 47,346).

If all domestic solid waste was collected in lieu of just kitchen waste, the percentage domestic to total would be 11.5% (4,100 x 4/3 ÷ 47,346).

One can readily see that the amount of domestic solid waste in a community's total solid waste program represents a relatively small part of the total. Of 11.5% approximately 60% of the domestic was measured and 40% was estimated.

We believe that our basis of estimating what the domestic quantity would be if the city collected all domestic waste is reasonably accurate and certainly adequate considering that it represents only about 4.6% of the total.

The explanation is of course a simplification of a rather complicated matter.

EXHIBIT 2-1a

We could go into the seasonally adjusted and compaction adjusted quantities and the on-site disposal factors which we will use in the report but at this time I do not believe it is necessary to the points we wish to make.

We have divided the City of Des Moines into three approximately equal collection districts. The First District in the northwest part of the City has been divided into what we consider efficient refuse collection routes. We propose to have the City follow our methods and standards and lay out the remaining two districts.

We recommend they start with our first district and change from their present routes in this area to the routes we have laid out. As soon as the routes have been in service for a reasonable period of time and have been adjusted as required, we recommend that they select several routes from which data will be collected. They will have dwelling counts, distances, volumes and weights to work with. After a few months we recommend they convert one or more routes to collection of all domestic solid waste as opposed to just domestic kitchen waste and collect data on this new basis. They would continue to collect data on the remaining selected routes which would be collecting only kitchen waste.

As soon as the first district has been established and functioning we recommend they change over to the new routes in the new second district and then in the new third district. After each of these districts becomes established they should collect data from these districts as they would in the first district.

Following this program they will have good data representing a good period of time from a known route distance and from a known number of dwelling units. They will have data showing the difference in refuse collected from routes which formally collected only kitchen waste and later collected all domestic solid waste. They will have parallel data on routes in the same area collecting all domestic solid waste and just kitchen waste.

This data can be used in planning the conversion of all routes to the collection of all domestic solid waste.

This data can be used in planning the conversion of all routes to the collection of all domestic solid waste.

Under the present operation the routes are very confused. They do not represent equal days work. Each week may represent a different amount of collection because some crews cover their routes more or less than once a week and many

EXHIBIT 2-1b

times crews are diverted to other areas as necessary or expedient to handle crisis situations. We do not have any way to evaluate what quantity of refuse is collected from what area on any reasonably accurate continuing basis. The new routes representing a days work to be accomplished each day, no more and no less on a consistent basis should give the necessary regularity for good data.

In summary we believe we are doing a professional job on this project. Where there is an opportunity to get good data we are expending maximum efforts to do so. In the case of the data being gathered at the point of disposal we have gone into this important aspect many times more thoroughly than I have ever seen done before. We think this is the key to the problem and are going to get everything available. In the case of the additional amount of refuse which would be collected if the community started collecting all domestic solid waste as opposed to their present practice of collecting only kitchen waste, we believe our estimates are entirely adequate and at least as good as any data could be under the present conditions. We believe that because of the fact that the additional quantities are so small compared to the entire picture nothing could be gained by attempting this data gathering now. This data will eventually be available when the present conditions of confusion are reduced and proper routes established.

The first of the computer runs have been made. These represent programs AB&C of a total program which will go to program H. We do not measure our work by the pound or by the ream but it might be interesting to note that computer runs AB&C produced 336 pages of type out. Part of this data will be reproduced in the report but we will have a full copy for your use if you would like to have it.

Yours very truly,

HENNINGSON, DURHAM & RICHARDSON
VEENSTRA & KIMM

RJ Peterson

R. J. Peterson, P.E.
Project Engineer
RJP:ea

cc: Mr. Johnson

EXHIBIT 2-1c

Exhibit 2-2

Elm Tree Statistical Calculations

I GENERAL

A.	Areas				
	1.	City of Des Moines			
		a.	Square Miles	65.6	
		b.	Acres	41,000	
	2.	Study Area			
		a.	Square Miles	430	
		b.	Acres	279,000	
B.	Mean Tree Measurements (Average of 350 samples at 100% density)				
	1.	Definitions			
		a.	100% Density - Total estimated material with same density as the log or trunk.		
		b.	Wet Weight - Green log or foliage material.		
		c.	Dry Weight - Oven dried material, 0% moisture.		
	2.	Diameter @ 18 inches from ground - Inches		34	
	3.	Overall Height - Feet		40	
	4.	Log or Bole (limb free trunk) volumes			
		a.	Length @ 50% of overall height - feet	20	
		b.	Diameter, 34" taper to 16" in 20' - inches	25	
		c.	Volume cubic feet (cubic yards)	68	(2.5)
	5.	Crown (upper foliage and limbs) absolute volumes (equal to Bole)			
		a.	Volume cubic feet (cubic yards)	68	(2.5)
	6.	Total Volume			
		a.	Cubic feet (cubic yards)	136	(5.0)

EXHIBIT 2-2

Exhibit 2-2 - Continued

7. Weights

a.	Pounds per cubic feet, wet	54. 3
b.	Pounds per cubic feet, dry	34
c.	Bole, wet (54. 3 x 68) - pounds (tons)	3, 572 (1. 8)
d.	Crown, wet (54. 3 x 68) - pounds (tons)	3, 572 (1. 8)
e.	Total tree, wet (54. 3 x 136) - pounds (tons)	7, 385 (3. 7)
f.	Total tree, dry (34 x 136) - pounds (tons)	4, 624 (2. 3)
g.	Ash residue (2. 2% of dry wt.) - pounds	102

II NUMBER OF TREES (estimated)

A. City of Des Moines

1.	Original Total, 1959	260, 000
2.	Acre Density	6. 3
3.	Disease History	

Public Trees

Year	Total	Diseased	% Loss
1959	65, 000	325	0. 50
1960	64, 675	807	1. 24
1961	63, 868	1, 182	1. 85
1962	62, 686	2, 445	3. 90
1963	60, 241	2, 710	4. 50
1964	57, 331	4, 247	7. 40
1965	53, 289	2, 241	4. 60
1966	50, 843	3, 475	6. 80
1967	47, 378	7, 730	16. 30

Private Trees

Year	Total	Diseased	% Loss
1959	195, 000	975	0. 50
1960	194, 025	2, 401	1. 24
1961	191, 619	3, 540	1. 85
1962	188, 079	7, 335	3. 90
1963	180, 744	8, 138	4. 50
1964	172, 606	12, 773	7. 40
1965	159, 833	7, 352	4. 60
1966	153, 481	25, 000	16. 40
1967	127, 481	19, 600	15. 40

EXHIBIT 2-2a

Exhibit 2-2 - Continued

Total City

Year	Total	Diseased	% Loss
1959	260,000	1,300	0.50
1960	258,700	3,213	1.24
1961	255,487	4,722	1.84
1962	250,765	9,780	3.90
1963	240,985	10,848	4.35
1964	230,137	17,020	7.40
1965	213,117	9,793	4.60
1966	203,324	28,465	14.00
1967	174,859	27,330	15.62

	a.	Public Tree Totals, Jan. 1968		
		(1)	Detected Diseased	25,352
		(2)	Down and Disposed, 100%	25,352
		(3)	Remaining Standing	39,648
	b.	Private Tree Totals, Jan. 1968		
		(1)	Detected Diseased	87,119
		(2)	Down and Disposed, 90%	78,407
		(3)	Remaining Standing	116,593
	c.	Total City of Des Moines		
		(1)	Detected Diseased	112,000
		(2)	Down and Disposed, 93% of Detected	104,000
		(3)	Remaining Standing, 60% of Original	156,000
	d.	Trees Saved, 1.3% of Remaining		2,000
	e.	Total Disposal Problem Trees, City of Des Moines		154,000
B.	Metropolitan Area (excluding Des Moines)			
	1.	Original Disposal Problem Trees, 1959		91,000
	2.	Detected, Down and Disposed, 1959-1968		9,000
		a.	Avg. for Period - Trees per Yr.	1,125
	3.	Remaining Standing Disposal Problem Trees		82,000
C.	Total Metropolitan Area Disposal Problem Trees			236,000

EXHIBIT 2-2b

Exhibit 2-2- Continued

III DISPOSAL METHODS

A. Commercial, Chip Processing for Pulp Use

1. Bole or Log

a.	Total Weight, tons (1.8 x 236,000)	425,000
b.	Waste, bark, @ 25% of total weight, tons	106,000
c.	Useful Product, tons	319,000

2. Crown, Foliage and Limbs

a.	Total Weight, tons (1.8 x 236,000)	425,000
b.	Waste, foliage, limbs, bark, @ 40% of total wt.	170,000
c.	Useful product, tons	255,000

3. Total Trees

a.	Total Weight, tons	850,000
b.	Waste, tons	276,000
c.	Total Useful Product, tons	574,000

4. Economics

a.	Cost of Machinery, M&O, Labor, amortized at $4.00/ton	$2,296,000
b.	Waste Disposal @ $3.00/ton	$ 276,000
c.	RR Freight, 200 miles or less, @ $3.00/ton	$1,722,000
d.	Preparation sub-total	$4,294,000
e.	Contingency, 10%	$ 429,000
f.	Total Preparation Processing Costs	$4,723,000
g.	Current FOB Mill Price for Chips @ $8.00/ton	$4,592,000
h.	Cost of Tree Disposal by Commercial Endeavor	$ 131,000

Exhibit 2-3

Packing House Waste Calculations

The individual volumes of kill from the several packers is considered confidential. However, it can be said that the total kill in June 1967 was approximately 1,870 head of beef per day. Some plans for expansion of the industry were divulged during our interviews, however, one packing company has closed their plant since the field information was gathered and the writing of this report. Because there are so many factors which could affect the future quantities which cannot be predicted with any real assurance, we have made a reasonable estimate of the kill at this time, and waste products which can be expected from these kills, and then projected the increase in this materal at the same rate as the commercial and industrial growth.

The annual quantity of pen sweepings and paunch manure expected for the present is as follows:

Kill:

1,500 head per day, 5.5 days for 52 weeks = 430,000 head per year

Paunch Manure Waste:

Weight @ 48 pounds per head	10,300 tons/year
Volume @ 77 cf per head	12,200 CY per year

Pen Sweeping Waste:

Weight at 10% of Paunch Manure	1,030 tons per year
Volume at 20% of Paunch Manure	2,440 CY per year

	Tons/year	CY/year
Paunch Manure	10,300	12,300
Pen Sweepings	1,030	2,440
Total	11,300	14,700

To adjust the volume for compaction, assume the following compaction factors:

Paunch Manure @ .8 x 12,200 = 9,860
Pan Sweepings @ .6 x 2,400 = 1,440

Total 11,200 cubic yards per year (compacted in place)

Exhibit 2-4

Sewage Solids Calculations

1. Grease: Scum and grease skimmings will be burned at the plant in incineration equipment currently being installed. No scum and grease skimmings are included in these quantities.

2. Grit: 35 CY per day based on 50 MGD Future Flow.

   1967 Quantity:
   30 MGD ÷ 50 MGD x 35 = 21 CY per day = 7,665 CY per year
   @ 2,430 lbs/CY = 18,600,000 lbs/yr = 9,300 tons/yr. wet
   9,300 tons/yr @ .50 solids = 4,650 tons/yr. DWS

3. Solids: 41,000 lbs/day DWS 1965, 56,000 lbs/day DWS 1985;
   plus 6.0% CaO + 1.5% $FeCl_3$

   1967 Quantity:
   41,000 + ((2 ÷ 20) x (56,000 - 41,000)) = 42,500 lbs/day,
   plus 7.5% chemical = 42,500 + 3,200 = 45,700 lbs/day =
   16,700,000 lbs/yr = 8,350 tons/yr. DWS

   Cake @ 75% moisture - 33,400 tons/yr. wet.

4. Screenings: Non-grindable removed at screens: 500 lbs/day wet
   500 x 365 = 182,000 lbs/yr = 91 tons/yr. wet.
   91 tons/yr. @ .30% solids = 27 tons/yr. DWS

5. Total Des Moines Plant Sewage Solids 1967 to Sanitary Landfill:

	Weight tons/yr.		
	Dry	Wet	CY/yr.
Grease & Scum	-0-	-0-	-0-
Grit	4,650	9,300	7,670
Solids	8,350	33,400	38,200
Screenings	27	91	150
Totals	13,000	43,000	46,000

6. Total Study Area Sewage Solids to Sanitary Landfill 1967:

1967 Population Study Area	289,000
1967 Des Moines Plant Population	240,000

Factor: 289,000 ÷ 240,000 = 1.20
Volume: 46,000 CY x 1.20 = 55,000 CY/yr.
Weight: 43,000 Tons x 1.20 = 51,500 tons/yr, wet
13,000 Tons x 1.20 = 15,600 tons/yr, DWS

EXHIBIT 2-4

Exhibit 2-4 - Continued

7. 1987 Study Area Sewage Solids to Sanitary Landfill:

Volume: 55,000 x (56,000 ÷ 41,000) = 75,000 CY/yr.
Weight: 51,500 x (56,000 ÷ 41,000) = 71,000 tons/yr, wet
15,600 x (56,000 ÷ 41,000) = 21,000 tons/yr, DWS

EXHIBIT 2-4a

Exhibit 2-5

Estimated Cost of Disposal of Sewage Solids By Incineration in a Sewage Solids Incinerator

1. Tons per day, DWS 1967, (15,600 TPY ÷ 365=) 42.7

This is the 1967 present load and includes grit, screenings, sewage solids, but no grease.

2. Tons per day, DWS 1987, (21,000 TPY ÷ 365=) 57.5

Same as item 1 above, but increased by factor account for 20 years growth to 1987, (156,000 x (56,000 ÷ 41,000) = 21,000 TPY). This is the 1987 quantity upon which the capacity is based.

3. Cost per ton, rated capacity \$21,000

This cost is based on reported construction cost of typical facilities, plus 8.65% for City administration, legal and engineering, and plus 10% contingency.

4. First Cost (line 2 x line 3) \$1,210,000

5. Amortization (line 4 x .0768) \$ 93,000

Annual payments, based on 20 year bonds @ 4.5%, factor of .0768.

6. Tons per year, DWS average day, average year 18,300

Average year - average of line 1 + line 2 times 365 days (42.7 + 57.5) ÷ 2 = 50.1 x 365 =

7. Maintenance and Operation line 6 x \$4.00 per ton) \$ 73,000

The \$4.00 per ton rate includes fuel, power, maintenance, water, and operational labor.

8. First Cost Amortization plus Maintenance and Operation (line 7 + line 8) \$ 166,200

This is the annual cost up to, but not including, the hauling and landfilling of the ash.

9 Inert percent in Solids 25%

This is the percent of ash expected when the sewage solids and grit and screenings are burned.

EXHIBIT 2-5

Exhibit 2-5 - Continued

10.	Tons per year, DWS ash, average day, average year (line 9 x line 6)	4,575
11.	Tons per year, wet ash, average day, average year	6,500
	Wet ash @ 70% solids in line 10.	
12.	Cost of hauling ($1.82 per ton x line 11)	$11,800
	The cost of hauling and landfilling the residue is the same as hauling and filling non-incinerated sewage solids at a public sanitary landfill site with other solid waste of the community	
13.	Total cost per average year (line 8 + line 12)	$178,000
14.	Cost per ton, average DWS (line 13 ÷ line 6)	$ 9.74
15.	Cost per ton, average wet basis (line 13 ÷ 61,200 TPY)	$ 2.91

Exhibit 2-6

Development of Unit Weights

General

Unit weights are intended to be typical of materials as delivered to the disposal site. Often loads are mixed, with two or more materials in each load. Seldom was there only one material on a load, although some material classes were meant to include a variety of materials peculiar to the origin or type of waste.

It was often impractical to define all components of a load. For instance, a load of glass from a bottling company also contained quantities of paper, cardboard, wood, tin cans, etc. Therefore, loads were estimated as to the volume of major components.

Weighing of waste as delivered to the site was done on a limited scale in order to obtain unit weight data on materials for which there was no other information and to substantiate data available from other sources. An attempt was made to select loads for weighing which were typical for that class of material, although some weighing of mixed loads was required. Mixed loads were analyzed on the basis of component parts to check the total weight of the load against known or assumed average weights of two or more components.

Many material densities were assigned based upon specific knowledge of the materials involved, while others are a matter of general knowledge. Past experience has provided knowledge of such items as paunch manure, sewage solids, rubber manufacturing wastes, cinders, fly ash, cement manufacturing wastes, and metal scrap. The bulk density of various materials are general knowledge, including dirt, gravel, rock, oils, grain, fruits and vegetables, furniture and appliances.

Weighing Program

Three approaches to weighing of refuse materials were taken. These are discussed in the following paragraphs.

City Collected Wastes - Approximately 90% of domestic kitchen wastes disposed of at the Des Moines No. 1 site was collected in packer trucks. As a part of the refuse collection study, a record was made of the volume and weight of refuse collected by Des Moines City packer trucks for at least one day on each of the 27 routes. From this data, unit weights were determined for 20 loads and averaged to determine a unit weight for material class 40, "Garbage and Kitchen Wastes, Domestic". The average density was 495 lb/CY, with a maximum of 640 lb/CY and a minimum of 375 lb/CY. A value of 500 lb/CY was used for computation purposes for this material class for wastes collected in packer trucks. This value was also assigned to material class 41 "Garbage and Kitchen Wastes, Commercial".

Exhibit 2-6 Continued

Weighing of Private Haulers - Private refuse haulers cooperated in obtaining unit weight data for several classes of material, particularly the "paper and cardboard" and "mixed trash and refuse" classes. There is considerable variation in the unit weight of these wastes depending upon whether they are collected in packer trucks or open body trucks, trailers or pickups. Private haulers weighed several loads of both packer and non-packer type trucks and recorded the corresponding volumes.

For material class 50 "Paper and Cardboard", the following results were obtained:

Open Truck:	Load #1 -	15 C.Y.	- 2,240 lbs.	- 149 lb/C.Y.
	Load #2 -	20 C.Y.	- 1,760 lbs.	- 88 lb/C.Y.
	Load #3 -	22 C.Y.	- 2,610 lbs.	- 109 lb/C.Y.
	Total	47 C.Y.	- 6,610	
	Average Unit Weight			116 lb/C.Y.
Packer Truck:	Load #1 -	27 C.Y.	- 7,430 lbs.	- 275 lb/C.Y.
	Load #2 -	10 C.Y.	- 4,820 lbs.	- 482 lb/C.Y.
	Load #3 -	17 C.Y.	- 8,290 lbs.	- 490 lb/C.Y.
	Load #4 -	12 C.Y.	- 3,340 lbs.	- 278 lb/C.Y.
	Total	66 C.Y.	- 23,880 lbs.	
	Average Unit Weight			362 lb/C.Y.

For computation purposes a unit weight for paper and cardboard of 120 lb/C.Y. was used for open body trucks and 360 lb/C.Y. for packer trucks.

Weighing of packer trucks from a commercial route considered typical for material class 42, "Mixed Trash and Refuse (Including Garbage)" produced the following results:

Packer Truck:	Load #1	16 C.Y.	- 7,390 lbs.	- 461 lb/C.Y.
	Load #2	27 C.Y.	- 10,620 lbs.	- 394 lb/C.Y.
	Total	43 C.Y.	- 18,010 lbs.	
	Average Unit Weight			419 lb/C.Y.

The unit weight used for material class 42 in packer trucks was 420 lb/C.Y. This weight was also assigned to category 43 "Mixed Trash and Refuse (No Garbage)".

The 3 to 1 compaction ratio of packer trucks to open trucks established in the weighing of paper and cardboard is believed to hold true in the other categories containing large quantities of paper. On that basis, open truck unit weights of 140 lb/C.Y. were assigned to material classes 42 and 43, and 167 lb/C.Y. for material classes 40 and 41. This general range was substantiated by weighing of city collected kitchen wastes in West Des Moines during a period when an open truck was being used for standby service.

Packer Truck Density - For the five material classes 40, 41, 42, 43 and 50, the 3 to 1 compaction ratio of packer to open truck density was incorporated into the computer program for determining the weight of material delivered to the disposal site. Unit weights listed in the table giving seasonal and compaction factors and unit weights are for open trucks. When these materials classes were delivered in packer trucks, both the unit weight and the compaction factor were automatically tripled. This eliminated the need for anticipating the ratio of packer trucks to open trucks in each material class and permitted the use of two unit weights for these materials rather than a single weighted average based on an anticipated ratio of truck type.

Random Weighing - The third approach to load weighing was random weighing of typical loads observed at the landfill sites. This was used exclusively for the demolition and tree waste categories, and also for other materials.

One load of bottles and broken glass from a bottling firm was weighed and a unit weight determined of approximately 700 lb/C.Y.

Three truck loads of scrap tires were weighed with the results as listed below:

Load #1 -	9.8 C.Y. -	4,250 lbs	- 437 lb/C.Y.
Load #2 -	9.8 C.Y. -	4,500 lbs	- 460 lb/C.Y.
Load #3 -	20.0 C.Y. -	7,280 lbs	- 364 lb/C.Y.
Total	39.6 C.Y. -	16,030 lbs	
Average Unit Weight			405 lb/C.Y.

Demolition wastes proved to be difficult to obtain reliable data due to the extreme variation in the weight of component materials and the proportion of each material in a given load. Three loads of combustible wastes from the demolition of wood frame structures were weighed with the following results:

Load #1 -	12.0 C.Y. -	4,200 lbs	- 350 lb/C.Y.
Load #2 -	12.0 C.Y.	7,000 lbs	- 530 lb/C.Y.
Load #3 -	12.5 C.Y.	6,250 lbs.	- 500 lb/C.Y.
Total	36.5 C.Y. -	17,450 lbs	
Average Unit Weight			480 lb/C.Y.

Exhibit 2-6 - Continued

These loads were loosely packed, mostly lumber, and observed to be less dense than the more commonly encountered mixed combustible and non-combustible demolition materials. Two loads of mixed demolition wastes were weighed, with the combustible materials of those loads assumed to be 600 lb/C. Y.

Load #1	17,200 lb.	7.3 C. Y. Comb.	3.7 C. Y. Non-Comb.
Load #2	6,900 lb.	2.0 C. Y. Comb.	4.0 C. Y. Non-Comb.
Total	24,100 lb.	9.3 C. Y. Comb.	7.7 C. Y. Non-Comb.

Combustible 9.3 C. Y. @ 600 lb/C. Y. = 5,600 lb.
Non-Comb. 24,100 - 5,600 = 18,500 lb.

Average Non-Combustible Unit Weight $= \frac{18,500}{7.7} = 2,400$ lb/C. Y.

The unit weights of 600 lb/C. Y. for combustible demolition wastes and 2,400 lb/C. Y. for non-combustibles are considered typical and used for computation purposes.

The density of limbs and leaves was found to be approximately 320/lb/C. Y. when chipped and 270 lb/C. Y. not chipped, determined by weighing one load of each of these materials. Logs and stumps were weighed as follows:

Load #1 - Logs greater than 10"
14.4 C. Y. - 9,600 lb. - 665 lb/C. Y.

Load #2 - Limbs and logs under 10"
12.0 C. Y. - 8,700 lb. - 724 lb/C. Y.

Load #3 - Logs and stumps - 80% greater than 10", 20% less than 10"
21.0 C. Y. - 8,750 lb. - 420 lb/C. Y.

Load #3 was delivered to the disposal site in a dump truck and the volume recorded is considered to be inaccurate, therefore, a unit weight of 675 lb/C. Y. has been used for logs and stumps, both greater and smaller than 10 inches in diameter.

Street sweepings were weighed by the City of Des Moines, with two loads weighing 86 and 83 lb/C.F. An average of 85 lb/C.F. is considered typical for street sweepings.

Also, one load of pen cleanings and associated animal feeding wastes were checked and found to weigh approximately 1,090 lb/C. Y. (40 lb/CF). This is slightly less than the 50 lb/C. F. experienced at some large stockyards, but the lower value is considered appropriate for pen sweepings disposed of at public sites in this case.

EXHIBIT 2-6c

Compaction Factors

Compaction factors were determined, based upon the anticipated density of the material in the fill as compared to the density as delivered to the disposal site. For instance, paper, cardboard, and general mixed rubbish should compact in the fill to approximately 600 lb/C. Y. If paper and cardboard are delivered to the disposal site in an open body truck at 120 lb/C. Y., the compaction factor is determined to be 120 ÷ 600 = 0.2. If the same material is delivered in a packer truck at 360 lb/C. Y., the compaction factor is 360 ÷ 600 = 0.6. Some materials will have a greater density delivered to the site than the compacted density of paper and other rubbish. In the case of liquids and semi-solids, little or no increase in the fill volume may be required, therefore a small compaction factor is used. Heavy granular and bulky wastes were evaluated in terms the anticipated volume reduction due to spreading, compacting and mixing with other materials in the landfill for assigning compaction factors.

This approach to assigning compaction factors has a definite advantage. The compaction factor is simply a conversion from the as-received volume to the compacted fill volume. By converting from the as-received density to the anticipated average fill density, possible inaccuracies of the as-received figures in the more loosely defined material classifications are negated in as far as the total required fill volume is concerned. This would not apply to demolition wastes, trees and bulky items which are not included in the stated average fill density but have been evaluated separately as to their expected volume reduction in place in the fill.

Conclusion

An important point which applies throughout this discussion of unit weights is clearly illustrated in the weighing of scrap tires. Reference is made to the variation in unit weights of the three loads, specifically 437, 460 and 364 lb/C. Y., even though a single, well defined material is involved. Out of necessity, average unit weights must be assigned to each material class in order to make an analysis of the total tonnage of waste material both now and in the future, and to investigate methods and procedures of final disposal. In reality, the unit weights of these materials will vary substantially. In the case of scrap tires, the density will depend upon the method placing or stacking of tires, size of load, type of tire (passenger car or large off-the-road equipment tire) and other factors. Across-the-board figures for density of refuse materials are often not adequately defined, subject to a multitude of influencing factors and can be quite misleading.

Exhibit 2-7

Instructions For Completing Landfill Survey Questionnaire

The form has eleven parts to which the following comments or instructions pertain:

1. Book Number -

   The book number which appears on the outside cover of the book of forms shall be recorded on each sheet.

2. Day -

   The day of the month data is recorded. The month and year will not be recorded on the forms.

3. Time -

   In this part, record the time on a 24-hour basis; i. e. 0800 indicates 8:00 A. M. and 1310 indicates 1:10 P. M. This time is the time the vehicle arrives at the landfill site. All men conducting the survey must have watches and they should be set to read alike.

4. County License Number -

   The number designating the Iowa County in which the vehicle is licensed shall be recorded. Official city license numbers will be recorded by the County in which the city is located. These are as follows:

Polk County: (77)	Des Moines, West Des Moines, Altoona, Ankeny, Bondurant, Clive, Grimes, Pleasant Hill, Urbandale, Windsor Heights.
Warren County: (91)	Carlisle, Norwalk

   Any other cities encountered should be handled in the same manner. Federal, State, out-of-state, or any other designation other than the 1 through 99 county numbers shall be recorded as "00".

5. Type of Vehicle -

   Indicate the type of vehicle by recording the proper number in the appropriate space. If the vehicle is not one of those listed, write in the type in the space available under "Other".

6. Type of Hauler -

In this part, indicate by recording the proper number which type of hauler is delivering the material to the site. If it is a contractor, select the type which is generating the waste. If it is a commercial hauler from a route which includes several customers, indicate whether the route is commercial waste, industrial waste or domestic waste, and the approximate percentages of each. Record both the number indicating type of hauler and the percentage of each waste; unless the waste is entirely of one classification in which case no percentage need be recorded. "Private Commercial" or "Private Industry" designates waste from a single commercial establishment or industry which may be hauling their own wastes or employing a commercial hauler.

7. Size of Load -

There are two ways to indicate the size of load. Use either way but not both. The first way is to give the size of the vehicle cargo space in cubic yards and then indicate the percent to which it is filled. The percent filled is not to be considered as a statement of density of the material but simply how much of the cargo space is being used. For example, a dump truck with a 5 CY capacity box piled half full of tin cans would be recorded as 5 CY x 50% full. The same truck with tree limbs piled higher than the side of the 5 CY box could be recorded as 5 CY x 120% full.

The other way to indicate size of load is to indicate the rough size of the load, giving the length, width and height of the cargo in feet. For example, a flat bed truck might have a load of scrap concrete blocks piled an average of 8' long x 4' wide by 2 feet high; or an automobile with grass clippings in baskets in the trunk could be described as a pile 2' long x 2' wide x 1' high.

Wastes carried by private citizens may be estimated at 0. 1 CY for each standard 20 gallon garbage can or equivalent.

8. Address of Source of Waste -

Approximate address should be given where possible to pinpoint source of waste. For example, if a contractor is wrecking a hotel building in the 900 block on Locust Street, indicate "9th and Locust". If a garage man is delivering a load of oil cans, indicate "Joe's Conoco Station, 15th & Grand Avenue". If a commercial hauler is from a commercial route in downtown Des Moines, indicate "Downtown Des Moines". Do not neglect to indicate which city the waste originates from. For City refuse vehicles the truck number and the route number will be sufficient source information.

Exhibit 2-7 - Continued

9. Condition of Material -

There is a place to record the proper number if the load is very dense or very loose. Use these to indicate the unusual condition. For example, in most wrecking jobs the refuse is usually piled in dump trucks with a clam shell or front end loader. The engineer evaluating these survey sheets will take this into account, but if a truck load of waste from a wrecking job was hand loaded, thereby getting much more than the usual amount into a truck, indicate that fact by placing a check in the "very dense" designation. Similarly, if a load of large cardboard boxes was loose and not in any way crushed or packed in, indicate "very loose".

10. Type of Material -

Indicate by one or more of the materials listed what type of material is being delivered. In the case of mixed loads, indicate more than one material.

If a load is mixed and has a high percentage of some types and a low percentage of others, give a rough approximation of the percentages. For example, a load of bricks from a wrecking job with some wood may be recorded, thus:

Type of Material

Mat'l	%	Mat'l	%	Mat'l	%	Mat'l	%
50 51 52	53 54 55	56 57 58	59 60 61	62 63 64	65 66 67	68 69 70	71 72 73
1	9 0	2	1 0				

1. Demolition - Mixed, Non-Combust.
2. Demolition - Mixed, Combust.

In the case of a typical load from a City Refuse Packer Truck, indicate "Garbage & Kitchen Waste, Domestic", but do not attempt to evaluate the percentage of any of the materials. "Construction Mixed" should indicate any scrap materials or other materials derived from the construction industry which do not fall into other specific categories listed. "Ashes and Cinders" shall designate the normal residue and clinkers from burning of coal and other combustibles as opposed to "Fly Ash" which would designate very fine, light matter.

If material cannot be described by checking one or more of the materials listed, write in as "Other" in the space available at the bottom of the page with a description of the material and any appropriate comments.

EXHIBIT 2-7b

11. Coordinate and Government Subdivision -

The coordinate of the source of waste and the government subdivision will be determined in the office by the person checking the survey sheets. No entry should be made for these items in the field.

In addition to the information requested on the Questionnaire, the following information should be recorded on the outside cover of each book:

1. The complete date including day of the week.
2. Name of each surveyor, the time which he began or quit, and the times the book was started and completed.
3. The number of the preceding book and the following book.

ERROR CODES
SHOWN THUS ①

DATA TEST PROGRAM
DMS SOLID WASTE STUDY
DUMP SURVEILLANCE

A. 17, 18 must be any number from 01 to and including 11.①

B. If 17, 18 is 01, 02, 03, 07, 08, 09, 10 or 11, then 20, 21 should be 00 which the program will convert to 100.②

C. If 17, 18 is 04, 05 or 06, then 20, 21 could be 00 or any other number.

D. If 17, 18 is 01, 02, 03, 07, 08, 09, 10 or 11, then 23③ and 28④ must be 0, also 25,⑤ 26 and 30,⑥ 31 must be 00.

E. If 17, 18 is 04, 05 or 06, then 23 and/or 28 may be one of the three numbers in the 04, 05⑦ or 06 series not used in 17, 18, or 23 or 28.

F. The sum of numbers appearing in 20, 21; 25, 26; and 30, 31 must not exceed 100.⑩

G. If no numbers or zeros appear in 23⑧ and/or 28⑨, then 25, 26 and 30, 31 respectively must also be 0.

H. Number 15 may be any number from 1 to and including 9.⑪

I. Number 49 must be 0, 1 or 2.⑫

J. Number 33, 34, 35 and 36 can be any number from 00.1 to 99.9 except as follows:

Number in Column 7	Range for 33, 34, 35 and 36	
	From	To
1	03.0	30.0
2	01.0	15.0
3	00.1	30.0
4 ⑬	00.1	05.0 ⑭
5	01.0	15.0
6	00.5	15.0
7	00.1	10.0
8	00.1	02.0
9	00.1	30.0

EXHIBIT 2-8

K. Columns 51, 52; 57, 58; 63, 64; ⑯ and 69, 70 may be any numbers from 01 to and including 73 except 08, 09, 16 through 19, 24, 28, 29, 33, 34, 39, 46, 47, 48, 49, 59, 64 ⑰ through 69; however, any number which is used may not be used in more than one place.⑮

L. The sum of 54, 55+60, 61+66, 67+72, 73 shall not exceed 100.⑱

M. If 51, 52 is 00, then 54, 55 must also be 00
If 57, 58 is 00, then 60, 61 must also be 00 ⑲
If 63, 64 is 00, then 66, 67 must also be 00
If 69, 70 is 00, then 72, 73 must also be 00

N. If 46, 47 is a certain number, then 38, 39, 40 and 42, 43, 44 must fall within certain limits as shown in attached Table "TEST LIMITS - CO-ORD. FOR GOV. SUBDIV." ⑳

O. Columns 7, 8, 9, 10 represent the time of day and must be from 0000 to and including 2400. The cards were punched in the same order as the pages in the books. The pages were used consecutively in the field; therefore, any given card should have a time (7, 8, 9, 10) which is equal to or greater than the time of the preceding card. This is true for any given book (Col. 1, 2) except where the day (Col. 4, 5) changes. In the case of a change of day, the time may change from 23++ to 0+++ or some similar change and then the following times must be the same or increasing as described above.㉑

TEST LIMITS - CO-ORD. FOR GOV. SUBDIV.

Gov. Sub-Div.	South			West		
	From		To	From		To
01	91	-	142	52	-	103
02	108	-	134	99	-	125
03	86	-	96	32	-	42
04	57	-	76	64	-	84
05	68	-	78	28	-	39
06	102	-	111	104	-	121
07	73	-	80	122	-	128
08	108	-	127	45	-	54
09	86	-	104	98	-	124
10	102	-	113	100	-	108
11	140	-	147	38	-	46
12	151	-	158	90	-	97
13	12	-	142	00	-	132
14	140	-	281	0	-	125
15	133	-	143	37	-	56
16	83	-	88	54	-	60
17	0	-	999	0	-	999
18	130	-	135	115	-	120
19	36	-	44	47	-	55
20	78	-	88	94	-	102
21	81	-	91	3	-	10
22	89	-	96	53	-	65
23	44	-	50	100	-	107
24	139	-	143	5	-	9
25	73	-	81	77	-	89
26	10	-	16	96	-	103
27	12	-	142	123	-	331
28	140	-	281	123	-	331
29	0	-	999	0	-	999
30	0	-	14	0	-	101
31	0	-	999	0	-	999
32	0	-	14	123	-	306
33	81	-	96	67	-	83

EXHIBIT 2-8b

WEST DES MOINES SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

WEST DESMOINES
ENTIRE DUMP

	CU. YDS AS RECEIVED	POUNDS AS RECEIVED	VEHICLES	SANITARY LAND FILL CU YDS**	SANITARY LAND FILL POUNDS*	INCINERATION TO INCINERATOR CU YDS*	INCINERATION TO INCINERATOR POUNDS*	INCINERATION TO LAND FILL CU YDS**	INCINERATION TO LAND FILL POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
400.	0.	0.	0.	0.	0.	0.	0.	0.	0.
500.	0.	0.	0.	0.	0.	0.	0.	0.	0.
600.	0.	0.	0.	0.	0.	0.	0.	0.	0.
700.	0.	0.	0.	0.	0.	0.	0.	0.	0.
800.	125.	68653.	7.	47.	50940.	37.	19188.	24.	31752.
900.	408.	261038.	85.	155.	192531.	191.	79048.	65.	113484.
1000.	346.	180057.	121.	103.	131007.	168.	39562.	54.	91444.
1100.	359.	177460.	137.	104.	133440.	217.	70233.	32.	63208.
1200.	256.	113241.	129.	76.	85388.	194.	58392.	10.	26996.
1300.	181.	125183.	121.	64.	98778.	119.	47344.	22.	51435.
1400.	190.	118409.	145.	58.	64784.	90.	19621.	34.	65164.
1500.	326.	140929.	148.	81.	98213.	179.	43822.	28.	54391.
1600.	508.	440453.	157.	199.	293421.	247.	96846.	80.	196575.
1700.	400.	323299.	142.	114.	207047.	177.	50347.	61.	156699.
1800.	211.	192666.	114.	65.	122574.	122.	32804.	30.	89770.
1900.	132.	55122.	115.	33.	38797.	88.	24542.	8.	14255.
2000.	31.	21571.	60.	8.	13682.	16.	2748.	4.	10934.
2100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS	3475.	2218119.	1481.	1106.	1550603.	1845.	584497.	454.	966106.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-9

NOT REPRODUCIBLE

WEST DES MOINES SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8.	2232.	44.	48708.	20.	16956.	27.	33984.	0.	0.	47.	50940.
100.	22852.	120.	169679.	49.	52045.	106.	140486.	1.	4637.	153.	187895.
146.	29749.	64.	101258.	19.	39072.	84.	91935.	1.	4573.	102.	126433.
125.	27008.	68.	106432.	3.	4683.	101.	128757.	1.	2355.	103.	130485.
115.	24451.	38.	60938.	3.	6857.	73.	78532.	1.	4445.	75.	30944.
58.	8238.	52.	90540.	20.	33678.	44.	65100.	6.	17174.	58.	81604.
69.	10752.	42.	74032.	13.	30993.	45.	53791.	8.	25778.	49.	59006.
152.	30434.	40.	67779.	10.	22124.	70.	76089.	6.	15524.	75.	79689.
181.	57133.	108.	236288.	54.	150639.	145.	142783.	43.	145003.	152.	148419.
127.	28813.	79.	178233.	47.	134992.	66.	72054.	43.	131572.	70.	75474.
87.	12566.	46.	110008.	33.	89299.	31.	33275.	28.	84103.	37.	38471.
59.	9589.	19.	29208.	3.	8810.	30.	29987.	2.	7681.	31.	31116.
14.	2123.	5.	11559.	3.	10055.	5.	3627.	3.	10055.	5.	3627.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1242.	265940.	725.	1284663.	276.	600204.	828.	950399.	149.	453500.	957.	1094103.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-9a

NOT REPRODUCIBLE

POLK COUNTY SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

POLK COUNTY
ENTIRE DUMP

	CU. YDS AS RECEIVED	POUNDS AS RECEIVED	VEHICLES	SANITARY LAND FILL		INCINERATION			
				CU YDS**	POUNDS*	TO INCINERATOR		TO LAND FILL	
						CU YDS*	POUNDS*	CU YDS**	POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
400.	0.	0.	0.	0.	0.	0.	0.	0.	0.
500.	0.	0.	0.	0.	0.	0.	0.	0.	0.
600.	0.	0.	0.	0.	0.	0.	0.	0.	0.
700.	0.	0.	0.	0.	0.	0.	0.	0.	0.
800.	0.	0.	0.	0.	0.	0.	0.	0.	0.
900.	139.	85383.	17.	50.	80225.	2.	281.	50.	79944.
1000.	80.	38831.	13.	27.	33569.	7.	1661.	25.	31908.
1100.	77.	36984.	13.	25.	31577.	3.	421.	24.	31156.
1200.	77.	35702.	12.	26.	33056.	19.	9334.	19.	23722.
1300.	54.	23261.	7.	16.	18967.	7.	1024.	15.	17943.
1400.	108.	49378.	17.	31.	40869.	23.	5356.	24.	35514.
1500.	72.	32719.	11.	22.	28231.	11.	2942.	19.	25289.
1600.	75.	50623.	16.	25.	47876.	7.	1238.	24.	46638.
1700.	34.	15855.	9.	10.	13279.	12.	3638.	6.	9641.
1800.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1900.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS	717.	372736.	115.	233.	327648.	91.	25894.	206.	301754.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-10

POLK COUNTY SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.	227.	50.	79998.	0.	0.	50.	80225.	0.	0.	50.	80225.
7.	1661.	25.	31908.	0.	0.	27.	33569.	0.	0.	27.	33569.
2.	279.	24.	31298.	0.	0.	25.	31577.	0.	0.	25.	31577.
18.	9030.	19.	24026.	0.	0.	26.	33056.	0.	0.	26.	33056.
0.	0.	16.	18967.	0.	0.	16.	18967.	0.	0.	16.	18967.
14.	4241.	26.	36629.	0.	0.	31.	40859.	0.	0.	31.	40869.
5.	277.	22.	27954.	1.	1037.	22.	27194.	0.	0.	22.	28231.
0.	13.	25.	47863.	2.	6336.	23.	41540.	2.	6336.	23.	41540.
8.	2128.	9.	11151.	2.	1296.	9.	11983.	0.	0.	10.	13279.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55.	17855.	216.	309794.	4.	8669.	229.	318979.	2.	6336.	231.	321312.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-10a

ANKENY SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

ANK
ENTIRE DUMP

	CU. YDS AS RECEIVED	POUNDS AS RECEIVED	VEHICLES	SANITARY LAND FILL		INCINERATION			
				CU YDS**	POUNDS*	TO INCINERATOR CU YDS*	TO INCINERATOR POUNDS*	TO LAND FILL CU YDS**	TO LAND FILL POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
400.	0.	0.	0.	0.	0.	0.	0.	0.	0.
500.	0.	0.	0.	0.	0.	0.	0.	0.	0.
600.	0.	0.	0.	0.	0.	0.	0.	0.	0.
700.	0.	0.	0.	0.	0.	0.	0.	0.	0.
800.	0.	0.	0.	0.	0.	0.	0.	0.	0.
900.	49.	27263.	10.	15.	19716.	40.	15782.	1.	5927.
1000.	75.	45459.	38.	23.	37673.	54.	16316.	7.	21357.
1100.	50.	7576.	34.	10.	7113.	49.	7113.	0.	0.
1200.	114.	44955.	33.	54.	40722.	91.	31179.	2.	5543.
1300.	121.	56421.	49.	36.	47110.	90.	19365.	10.	27746.
1400.	112.	54594.	48.	32.	49014.	84.	17674.	11.	31540.
1500.	129.	71265.	40.	48.	58714.	97.	32747.	9.	25967.
1600.	171.	48105.	42.	69.	42509.	152.	40854.	1.	1655.
1700.	104.	60096.	36.	47.	44332.	82.	31448.	4.	12884.
1800.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1900.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS	925.	415775.	324.	335.	346906.	739.	212478.	45.	134428.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-11

ANKENY SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13.	1618.	12.	18101.	4.	6457.	11.	13262.	1.	3937.	14.	15782.
33.	4186.	16.	33487.	1.	4579.	22.	33094.	1.	4579.	22.	33094.
33.	4051.	3.	3062.	0.	0.	10.	7113.	0.	0.	10.	7113.
79.	27121.	6.	13601.	0.	0.	54.	40722.	0.	0.	54.	40722.
48.	7419.	24.	39692.	1.	3533.	35.	43578.	1.	3533.	35.	43578.
70.	9396.	16.	39618.	0.	0.	32.	49014.	0.	0.	32.	49014.
60.	13926.	24.	44789.	0.	0.	48.	58714.	0.	0.	48.	58714.
132.	35607.	6.	6901.	0.	906.	68.	41603.	0.	906.	68.	41603.
73.	21616.	9.	22717.	2.	5832.	45.	38500.	2.	5832.	45.	38500.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
541.	124939.	116.	221968.	8.	21307.	325.	325600.	5.	18787.	328.	328120.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-110

EUCLID SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

EUCLID
ENTIRE DUMP

	CU. YDS AS RECEIVED	POUNDS AS RECEIVED	VEHICLES	SANITARY LAND FILL		INCINERATION			
				CU YDS**	POUNDS*	TO INCINERATOR CU YDS*	TO INCINERATOR POUNDS*	TO LAND FILL CU YDS**	TO LAND FILL POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
400.	0.	0.	0.	0.	0.	0.	0.	0.	0.
500.	0.	0.	0.	0.	0.	0.	0.	0.	0.
600.	0.	0.	0.	0.	0.	0.	0.	0.	0.
700.	0.	0.	0.	0.	0.	0.	0.	0.	0.
800.	184.	50540.	55.	46.	43607.	163.	40938.	2.	2669.
900.	430.	159776.	139.	105.	123436.	319.	78927.	23.	44509.
1000.	483.	152528.	186.	121.	118900.	372.	81519.	16.	37381.
1100.	491.	211186.	200.	145.	158378.	327.	82174.	36.	76204.
1200.	369.	182569.	180.	99.	142093.	241.	68317.	33.	73775.
1300.	321.	117918.	174.	80.	88832.	232.	47602.	17.	41230.
1400.	467.	217485.	220.	109.	159154.	301.	73128.	31.	86026.
1500.	490.	216863.	239.	130.	154358.	309.	79281.	38.	75077.
1600.	617.	302800.	257.	152.	217745.	363.	119243.	45.	98502.
1700.	375.	174401.	233.	96.	125827.	238.	77013.	26.	48814.
1800.	4.	995.	6.	1.	793.	4.	793.	0.	0.
1900.	4.	2896.	1.	1.	1948.	0.	0.	1.	1948.
2000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2100.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2200.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2300.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS	4235.	1789956.	1890.	1084.	1335069.	2868.	748934.	269.	586135.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-12

EUCLID SITE
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
101.	19292.	22.	24315.	5.	5404.	41.	38203.	0.	292.	46.	43315.
229.	32068.	57.	91368.	6.	17137.	99.	106298.	5.	16165.	100.	107270.
287.	51633.	45.	67267.	14.	23079.	107.	95821.	4.	14519.	117.	104381.
205.	42910.	80.	115467.	32.	56135.	113.	102243.	12.	38369.	133.	119989.
138.	21974.	68.	120119.	12.	34768.	87.	107324.	9.	32464.	89.	109628.
128.	17975.	53.	70857.	12.	17718.	68.	71114.	3.	9914.	77.	78918.
199.	36229.	62.	122925.	15.	36851.	93.	122303.	11.	32999.	98.	126155.
182.	31886.	86.	122472.	30.	53042.	100.	101316.	8.	25934.	122.	128424.
240.	35960.	98.	177785.	19.	42228.	133.	175517.	10.	34812.	142.	182933.
118.	20079.	69.	105747.	9.	21402.	86.	104425.	5.	16826.	90.	109001.
2.	315.	0.	478.	0.	0.	1.	793.	0.	0.	1.	793.
0.	0.	1.	1948.	0.	0.	1.	1948.	0.	0.	1.	1948.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1826.	314322.	643.	1020748.	155.	307764.	930.	1027306.	68.	222313.	1016.	1112756.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-12a

DES MOINES SITE #1
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

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DESMOINES #1
ENTIRE DUMP
                                                                      INCINERATION
          CU. YDS    POUNDS    VEHICLES  SANITARY LAND FILL
            AS         AS                CU YDS**  POUNDS*     TO INCINERATOR        TO LAND FILL
         RECEIVED  RECEIVED                                  CU YDS*    POUNDS*   CU YDS**    POUNDS*

    0.      134.     55416.        6.        62.    52346.      123.     49430.         3.      2916.
  100.      105.     30034.        6.        42.    28607.       96.     25691.         3.      2916.
  200.       58.     19536.        3.        32.    18734.       56.     18734.         0.         0.
  300.       41.     17830.        3.        11.    13759.       35.      4260.         4.      9499.
  400.       95.     25116.        5.        30.    22584.       91.     17754.         2.      4830.
  500.      187.     70263.       19.        77.    60957.      169.     45018.         6.     15939.
  600.      318.     72726.       20.       103.    69172.      303.     64731.         3.      4441.
  700.      388.    132377.       49.        99.   111300.      339.     66355.        13.     44945.
  800.     1155.    403180.      151.       323.   347568.      963.    201678.        62.    145890.
  900.     2141.    716320.      283.       579.   598281.     1890.    383542.        52.    214739.
 1000.     1924.    564484.      307.       540.   486117.     1703.    386101.        41.    100016.
 1100.     1916.    844695.      319.       727.   718521.     1602.    499049.        63.    219472.
 1200.     1739.    666519.      322.       696.   573775.     1470.    433100.        63.    140675.
 1300.     1469.    525895.      281.       480.   448949.     1248.    341590.        50.    107359.
 1400.     1647.    645999.      282.       580.   600595.     1397.    443444.        74.    157151.
 1500.     3233.   1551956.      378.      2038.  1393342.     2867.   1243478.        94.    149864.
 1600.     1221.    402062.      227.       350.   339800.     1061.    253471.        38.     86329.
 1700.      697.    276521.      155.       202.   234310.      540.    132528.        31.    101782.
 1800.      850.    332971.      156.       324.   328392.      723.    282960.        45.     45431.
 1900.      424.    195653.       79.       132.   152399.      345.     88836.        25.     63563.
 2000.      275.    103757.       37.        93.    98348.      249.     93104.         4.      5245.
 2100.      342.    104527.       23.       159.   102547.      333.     99712.         2.      2835.
 2200.       60.     14598.        6.        22.    14094.       58.     14094.         0.         0.
 2300.       36.     10083.        2.        11.    10083.       28.      3360.         6.      6723.


 TOTALS   20454.   7782516.     3119.      7715.  6824583.    17695.   5192021.       583.   1632562.


* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS
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EXHIBIT 2-13

DES MOINES SITE #1
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
98.	28127.	18.	24219.	0.	0.	62.	52346.	0.	0.	62.	52346.
96.	25691.	3.	2916.	0.	0.	42.	28607.	0.	0.	42.	28607.
56.	18734.	0.	0.	0.	0.	32.	18734.	0.	0.	32.	18734.
35.	4260.	4.	9499.	0.	0.	11.	13759.	0.	0.	11.	13759.
91.	17754.	2.	4830.	0.	0.	30.	22584.	0.	0.	30.	22584.
163.	43976.	8.	16981.	0.	0.	77.	60957.	0.	0.	77.	60957.
298.	64307.	4.	4865.	0.	0.	103.	69172.	0.	0.	103.	69172.
312.	51869.	23.	59431.	6.	15721.	93.	95579.	4.	12751.	95.	98549.
783.	130906.	120.	216662.	13.	25640.	311.	321928.	7.	20526.	317.	327040.
1551.	277330.	169.	320951.	18.	24089.	561.	574192.	3.	9005.	576.	589276.
1306.	304643.	116.	181474.	23.	23929.	518.	462187.	1.	5191.	539.	480925.
1409.	420197.	138.	298324.	25.	31424.	702.	687097.	4.	13460.	723.	705061.
1294.	361955.	131.	211821.	27.	50948.	669.	522827.	12.	38492.	684.	535283.
1037.	245929.	127.	203020.	21.	40549.	459.	408401.	10.	31081.	470.	417869.
1124.	355299.	163.	245296.	38.	57148.	542.	543447.	10.	28624.	570.	571971.
2660.	1144721.	182.	248622.	5.	9848.	2034.	1383494.	1.	4520.	2037.	1388822.
870.	183684.	97.	156116.	17.	34384.	333.	305416.	9.	27151.	341.	312649.
412.	82118.	77.	152193.	15.	27912.	187.	206398.	6.	17568.	196.	216742.
620.	251695.	80.	76697.	6.	6214.	318.	322178.	1.	1750.	324.	326642.
260.	45392.	66.	107006.	4.	3820.	128.	143579.	3.	7632.	130.	144767.
233.	89935.	8.	8413.	0.	0.	93.	98348.	0.	0.	93.	98348.
313.	89376.	13.	13171.	0.	0.	159.	102547.	0.	0.	159.	102547.
58.	14094.	0.	0.	0.	0.	22.	14094.	0.	0.	22.	14094.
28.	3360.	6.	6723.	0.	0.	11.	10083.	0.	0.	11.	10083.
15309.	4255355.	1552.	2569228.	217.	356625.	7499.	6467958.	70.	217753.	7645.	6606830.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-130

DES MOINES SITE #2

QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS

COMPUTER PROGRAM A

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DESMOINES #2
ENTIRE DUMP
         CU. YDS   POUNDS    VEHICLES  SANITARY LAND FILL              INCINERATION
           AS        AS                CU YDS**  POUNDS*    TO INCINERATOR        TO LAND FILL
         RECEIVED  RECEIVED                                 CU YDS*   POUNDS*   CU YDS**  POUNDS**

     0.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   100.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   200.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   300.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   400.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   500.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   600.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   700.       0.        0.         0.       0.        0.        0.        0.        0.        0.
   800.     497.   238984.        66.     151.   192257.      212.    61314.       74.   130943.
   900.     695.   495151.       114.     230.   337551.      337.   134783.       93.   202768.
  1000.    1267.   812037.       155.     405.   569678.      507.   190873.      203.   378805.
  1100.    1723.  1003134.       204.     523.   696294.      737.   279264.      236.   417030.
  1200.    1765.   999974.       160.     531.   724090.      648.   220534.      307.   503556.
  1300.    1954.  1169705.       204.     601.   817944.      774.   270488.      319.   547456.
  1400.    1993.  1266658.       226.     631.   885396.      834.   296290.      313.   589106.
  1500.    1886.  1353243.       236.     609.   925155.      740.   296338.      316.   528817.
  1600.    1997.  1194312.       228.     623.   846060.      820.   316229.      316.   529831.
  1700.    1566.   841194.       181.     466.   603816.      596.   226674.      243.   377142.
  1800.    1099.   475712.       125.     312.   341888.      497.   181815.      120.   160073.
  1900.     725.   382470.        95.     224.   284069.      203.    73922.      149.   210148.
  2000.     347.   133069.        50.      90.   101065.      156.    42559.       44.    58506.
  2100.      34.    14630.         9.      10.     9750.       20.     8348.        1.     1402.
  2200.       0.        0.         0.       0.        0.        0.        0.        0.        0.
  2300.       0.        0.         0.       0.        0.        0.        0.        0.        0.

TOTALS    17547. 10380274.      2073.    5408.  7335014.     7081.  2599432.     2735.  4735582.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS
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EXHIBIT 2-14

DES MOINES SITE #2
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
91.	23898.	122.	168359.	10.	20543.	141.	171713.	2.	7349.	149.	184907.
137.	27854.	195.	309657.	111.	183535.	119.	154016.	33.	100822.	197.	236729.
258.	57876.	337.	511802.	138.	243870.	268.	325808.	43.	135576.	363.	434102.
422.	105932.	403.	590362.	179.	276212.	344.	420083.	36.	112686.	487.	583608.
346.	84309.	433.	639781.	107.	193627.	424.	530463.	31.	95489.	500.	628601.
428.	104712.	480.	713232.	162.	313738.	439.	504206.	60.	188696.	542.	629248.
364.	82226.	534.	803170.	206.	354642.	426.	530754.	49.	151557.	582.	733839.
390.	91384.	503.	833771.	242.	435625.	368.	489529.	82.	252895.	527.	672260.
387.	90604.	517.	755456.	159.	282901.	468.	563159.	42.	130423.	581.	715637.
274.	66141.	390.	537675.	96.	157208.	369.	446608.	16.	49471.	450.	554345.
258.	64579.	239.	277309.	78.	75697.	234.	266191.	3.	11482.	309.	330406.
91.	21435.	200.	262634.	31.	50971.	193.	233098.	3.	8678.	222.	275391.
105.	22121.	64.	78944.	4.	5753.	86.	95312.	1.	2549.	89.	98516.
6.	1522.	8.	8228.	5.	4140.	5.	5610.	0.	0.	10.	9750.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3557.	844594.	4426.	6490420.	1525.	2598462.	3884.	4736552.	401.	1247673.	5008.	6087340.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-14a

ALL SITES

QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS

COMPUTER PROGRAM A

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TOTALS OF ALL DAYS
  ALL DUMPS
           CU. YDS    POUNDS   VEHICLES  SANITARY LAND FILL              INCINERATION
             AS         AS                CU YDS**  POUNDS*   TO INCINERATOR         TO LAND FILL
          RECEIVED  RECEIVED                                  CU YDS*   POUNDS*  CU YDS**   POUNDS*

    0.       134.     55416.       6.        62.     52346.      123.     49430.        3.     2916.
  100.       105.     30034.       6.        42.     28607.       96.     25691.        3.     2916.
  200.        58.     19536.       3.        32.     18734.       56.     18734.        0.        0.
  300.        41.     17830.       3.        11.     13759.       35.      4260.        4.     9499.
  400.        95.     25116.       5.        30.     22584.       91.     17754.        2.     4830.
  500.       187.     70263.      19.        77.     60957.      169.     45018.        6.    15939.
  600.       318.     72726.      20.       103.     69172.      303.     64731.        3.     4441.
  700.       388.    132377.      49.        99.    111300.      339.     66355.       13.    44945.
  800.      1960.    761396.     279.       568.    634372.     1375.    323117.      162.   311254.
  900.      3862.   1748931.     648.      1133.   1351742.     2780.    692361.      283.   659381.
 1000.      4174.   1793436.     820.      1220.   1376942.     2811.    716032.      347.   660911.
 1100.      4617.   2281035.     907.      1534.   1745323.     2935.    938254.      391.   307069.
 1200.      4320.   2042959.     856.      1481.   1599125.     2662.    820856.      434.   778269.
 1300.      4100.   2018383.     836.      1278.   1520581.     2470.    727412.      433.   793168.
 1400.      4517.   2352522.     938.      1441.   1819813.     2729.    855513.      487.   964300.
 1500.      6137.   3366976.    1052.      2929.   2658013.     4203.   1698609.      504.   959405.
 1600.      4590.   2438354.     931.      1419.   1787411.     2650.    827882.      504.   959529.
 1700.      3177.   1691365.     756.       934.   1228611.     1644.    521648.      371.   706962.
 1800.      2163.   1002344.     401.       702.    793647.     1347.    498372.      196.   295274.
 1900.      1285.    636141.     290.       391.    477213.      636.    187299.      183.   289914.
 2000.       653.    258397.     147.       191.    213096.      422.    138411.       52.    74685.
 2100.       376.    119157.      32.       169.    112297.      353.    108061.        4.     4237.
 2200.        60.     14598.       6.        22.     14094.       58.     14094.        0.        0.
 2300.        36.     10083.       2.        11.     10083.       28.      3360.        6.     6723.


TOTALS     47353.  22959376.    9012.     15881.  17719824.    30319.   9363255.     4391.  8356569.


* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS
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EXHIBIT 2-15

ALL SITES

QUANTITY OF REFUSE BY DISPOSAL PROCESS AND BY HOURS OF THE DAY, FOR ALL DAYS

COMPUTER PROGRAM A

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
98.	28127.	18.	24219.	0.	0.	62.	52346.	0.	0.	62.	52346.
96.	25691.	3.	2916.	0.	0.	42.	28607.	0.	0.	42.	28607.
56.	18734.	0.	0.	0.	0.	32.	18734.	0.	0.	32.	18734.
35.	4260.	4.	9499.	0.	0.	11.	13759.	0.	0.	11.	13759.
91.	17754.	2.	4830.	0.	0.	30.	22584.	0.	0.	30.	22584.
163.	43976.	8.	16981.	0.	0.	77.	60957.	0.	0.	77.	60957.
298.	64307.	4.	4865.	0.	0.	103.	69172.	0.	0.	103.	69172.
312.	51869.	23.	59431.	6.	15721.	93.	95579.	4.	12751.	95.	98549.
983.	176328.	308.	458043.	48.	68543.	519.	565828.	9.	28169.	559.	606202.
2031.	361949.	603.	989793.	188.	283263.	945.	1068479.	43.	134566.	1090.	1217176.
2236.	449747.	604.	927195.	195.	334529.	1025.	1042413.	51.	164439.	1169.	1212503.
2196.	600377.	716.	1144946.	239.	368453.	1295.	1376870.	53.	167489.	1481.	1577833.
1991.	528840.	696.	1070285.	148.	286201.	1333.	1312924.	53.	170890.	1428.	1428235.
1699.	384273.	753.	1136308.	217.	409216.	1061.	1111365.	80.	250397.	1198.	1270183.
1839.	498143.	842.	1321669.	271.	479634.	1169.	1340179.	78.	238957.	1363.	1580856.
3449.	1312626.	858.	1345387.	287.	521676.	2642.	2136337.	98.	301873.	2831.	2356140.
1810.	407001.	851.	1380409.	248.	517393.	1172.	1270018.	112.	344631.	1308.	1442780.
1011.	220894.	631.	1007716.	172.	348642.	763.	879968.	73.	221269.	862.	1007342.
968.	329156.	365.	464491.	117.	171209.	585.	622437.	32.	97334.	670.	696312.
410.	76417.	286.	400796.	38.	68601.	353.	408612.	8.	23992.	383.	453221.
352.	114179.	76.	98917.	8.	15808.	183.	197288.	4.	12604.	187.	200492.
319.	90898.	21.	21400.	5.	4140.	164.	108157.	0.	0.	169.	112297.
58.	14094.	0.	0.	0.	0.	22.	14094.	0.	0.	22.	14094.
28.	3360.	6.	6723.	0.	0.	11.	10083.	0.	0.	11.	10083.
22530.	5823003.	7678.	11896820.	2187.	3893030.	13694.	13826794.	696.	2169362.	15185.	15550462.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-15a

ALL SITES
QUANTITIES OF REFUSE BY DISPOSAL PROCESS AND BY TYPE OF VEHICLES, FOR ALL DAYS
COMPUTER PROGRAM B

	CU. YDS AS RECEIVED	POUNDS AS RECEIVED	VEHICLES	SANITARY LAND FILL CU YDS**	SANITARY LAND FILL POUNDS*	INCINERATION TO INCINERATOR CU YDS*	INCINERATION TO INCINERATOR POUNDS*	INCINERATION TO LAND FILL CU YDS**	INCINERATION TO LAND FILL POUNDS*
1.	6124.	3687197.	450.	4437.	3399021.	5469.	2890044.	162.	508976.
2.	9748.	7029965.	983.	3212.	4748289.	4995.	1632666.	1428.	3115623.
3.	5670.	1036959.	517.	1234.	945070.	5125.	772937.	90.	172133.
4.	849.	365167.	395.	225.	287015.	523.	143173.	74.	143843.
5.	1101.	426911.	40.	315.	300636.	753.	234996.	38.	65640.
6.	13330.	5800245.	1153.	3699.	4422066.	6404.	1857214.	1765.	2564852.
7.	9191.	4083059.	2855.	2420.	3187785.	6115.	1626083.	728.	1561702.
8.	903.	261267.	2556.	203.	216954.	642.	119468.	54.	97486.
9.	437.	268567.	63.	136.	212988.	292.	86674.	51.	126314.
TOTALS	47353.	22959376.	9012.	15881.	17719824.	30319.	9363255.	4391.	8356569.

COMPOSTING TO COMPOSTING CU YDS*	COMPOSTING TO COMPOSTING POUNDS*	COMPOSTING TO LAND FILL CU YDS**	COMPOSTING TO LAND FILL POUNDS*	DRY LAND FILL MATL FOR DRY FILL CU YDS**	DRY LAND FILL MATL FOR DRY FILL POUNDS*	DRY LAND FILL MATL NOT FOR DRY LF CU YDS**	DRY LAND FILL MATL NOT FOR DRY LF POUNDS*	WET LAND FILL MATL FOR WET FILL CU YDS**	WET LAND FILL MATL FOR WET FILL POUNDS*	WET LAND FILL MATL NOT FOR WET LF CU YDS**	WET LAND FILL MATL NOT FOR WET LF POUNDS*
5359.	2812251.	239.	586769.	8.	23306.	4429.	3375714.	7.	21870.	4430.	3377151.
3396.	717023.	2324.	4031266.	1345.	2595807.	1867.	2152482.	484.	1492400.	2729.	3255889.
4403.	578386.	323.	366684.	38.	45158.	1197.	899912.	4.	12742.	1230.	932328.
324.	72589.	146.	214426.	39.	64125.	185.	222890.	13.	39519.	212.	247496.
444.	88064.	205.	212572.	126.	125388.	189.	175248.	0.	0.	315.	300636.
4188.	815876.	2672.	3606190.	261.	429038.	3438.	3993028.	82.	263299.	3617.	4158767.
3774.	646341.	1564.	2541443.	336.	542130.	2084.	2645655.	102.	323404.	2319.	2864381.
486.	72956.	101.	143998.	15.	26616.	188.	190338.	5.	16128.	198.	200826.
158.	19516.	104.	193472.	20.	41461.	116.	171527.	0.	0.	136.	212988.
22530.	5823003.	7678.	11896820.	2187.	3893030.	13694.	13826794.	696.	2169362.	15185.	15550462.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-16

ALL SITES
QUANTITY OF REFUSE BY DISPOSAL PROCESS AND TYPE OF HAULER FOR ALL DAYS
COMPUTER PROGRAM C

	CU. YDS AS RECEIVED	POUNDS AS RECEIVED	VEHICLES	SANITARY LAND FILL		INCINERATION			
						TO INCINERATOR		TO LAND FILL	
				CU YDS**	POUNDS*	CU YDS*	POUNDS*	CU YDS**	POUNDS*
1.	2896.	2965352.	401.	1106.	1858646.	1222.	780987.	432.	1077659.
2.	1601.	2070729.	151.	700.	1251279.	469.	297471.	378.	953809.
3.	16.	17152.	2.	7.	10291.	6.	3852.	2.	6439.
4.	3156.	998932.	456.	984.	809318.	2424.	605207.	130.	204111.
5.	7961.	3275942.	804.	2992.	2751302.	6805.	1891641.	357.	859661.
6.	1091.	828300.	92.	511.	826688.	970.	586639.	51.	240049.
7.	16915.	6936319.	1795.	4622.	5437272.	8834.	2372736.	2071.	3064536.
8.	2552.	842053.	242.	652.	743215.	2322.	525740.	62.	217475.
9.	2835.	1403018.	229.	2134.	1248593.	2415.	1163181.	53.	85411.
10.	1627.	946272.	205.	500.	695156.	671.	153813.	308.	541343.
11.	6703.	2675306.	4628.	1673.	2088063.	4182.	981988.	547.	1106076.
TOTALS	47353.	22959376.	9012.	15881.	17719824.	30319.	9363255.	4391.	8356569.

COMPOSTING				DRY LAND FILL				WET LAND FILL			
TO COMPOSTING		TO LAND FILL		MATL FOR DRY FILL		MATL NOT FOR DRY LF		MATL FOR WET FILL		MATL NOT FOR WET LF	
CU YDS*	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*	CU YDS**	POUNDS*
310.	74336.	1017.	1784311.	669.	1165610.	437.	693036.	220.	692745.	886.	1165901.
9.	2450.	697.	1248829.	668.	1184780.	32.	66499.	141.	438334.	558.	812945.
0.	0.	7.	10291.	4.	3852.	2.	6439.	0.	0.	7.	10291.
2085.	464917.	256.	344401.	39.	64814.	945.	744503.	14.	42462.	970.	766856.
5863.	1543834.	737.	1207468.	175.	418298.	2817.	2333004.	123.	373694.	2869.	2377608.
823.	526305.	103.	300383.	8.	10492.	503.	816196.	0.	0.	511.	826688.
5950.	1170354.	3137.	4266919.	319.	499591.	4304.	4937681.	83.	259856.	4539.	5177416.
1739.	257312.	282.	485902.	12.	27324.	640.	715891.	8.	23760.	644.	719455.
2411.	1161267.	55.	87325.	3.	8165.	2131.	1240428.	3.	8165.	2131.	1240428.
598.	122341.	342.	572815.	55.	128290.	445.	566866.	31.	97747.	469.	597410.
2742.	499887.	1045.	1588176.	235.	381813.	1438.	1706250.	73.	232599.	1601.	1855464.
22530.	5823003.	7678.	11896820.	2187.	3893030.	13694.	13826794.	696.	2169362.	15185.	15550462.

* ADJUSTED FOR SEASONAL FACTOR

** ADJUSTED FOR SEASONAL AND COMPACTION FACTORS

EXHIBIT 2-17

ALL SITES
AS RECEIVED QUANTITIES OF REFUSE BY TYPE OF VEHICLE AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM D

TOTALS AS RECEIVED

TIME	PACKER CU YDS	PACKER POUNDS	PACKER # VEHICLES	DUMP CU YDS	DUMP POUNDS	DUMP # VEHICLES	VAN CU YDS	VAN POUNDS	VAN # VEHICLES
0.	84.	46896.	3.	0.	0.	0.	47.	5604.	2.
100.	54.	21060.	2.	21.	2926.	2.	26.	3132.	1.
200.	43.	17736.	2.	15.	1800.	1.	0.	0.	0.
300.	0.	0.	0.	6.	13570.	1.	35.	4260.	2.
400.	27.	10380.	2.	3.	6900.	1.	65.	7836.	2.
500.	92.	36000.	6.	34.	18975.	6.	51.	6156.	3.
600.	108.	43290.	6.	5.	424.	1.	177.	21322.	8.
700.	41.	41700.	3.	38.	13720.	4.	198.	25342.	13.
800.	131.	108556.	10.	491.	208313.	47.	424.	76148.	34.
900.	286.	252404.	22.	939.	557663.	88.	595.	83401.	46.
1000	283.	121324.	23.	956.	637449.	97.	605.	96900.	57.
1100.	604.	444611.	49.	1194.	758509.	115.	321.	79434.	36.
1200.	620.	335802.	42.	784.	552949.	81.	422.	79058.	37.
1300.	282.	125640.	23.	784.	680732.	85.	369.	87384.	49.
1400.	334.	219513.	27.	1059.	951540.	119.	565.	89775.	53.
1500.	2216.	1275409.	160.	950.	728937.	101.	444.	92590.	52.
1600.	297.	156831.	21.	1145.	1026264.	111.	566.	111829.	54.
1700.	114.	48588.	9.	563.	478775.	56.	220.	80586.	33.
1800.	155.	161952.	13.	418.	281828.	34.	192.	27452.	14.
1900.	53.	70299.	5.	180.	60090.	17.	156.	29268.	10.
2000.	47.	50964.	6.	113.	39097.	12.	71.	9341.	4.
2100.	227.	87000.	13.	32.	7260.	3.	75.	8976.	4.
2200.	28.	10800.	3.	19.	2244.	1.	9.	1122.	1.
2300.	0.	0.	0.	0.	0.	0.	36.	10083.	2.
TOTALS	6124.	3687197.	450.	9748.	7029965.	983.	5670.	1036999.	517.
AVERAGE PER VEHICLE	14.	8194.	0.	10.	7152.	0.	11.	2006.	0.

EXHIBIT 2-18

ALL SITES
AS RECEIVED QUANTITIES OF REFUSE BY TYPE OF VEHICLE AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM D

LIGHT TRAILERS			HEAVY TRAILERS			FLAT BED			PICKUP		
CU YDS	POUNDS	# VEHICLES	CU YDS	POUNDS	# VEHICLES	CU YDS	POUNDS	# VEHICLES	CU YDS	POUNDS	# VEHICLES
0.	0.	0.	0.	0.	0.	0.	0.	0.	4.	2916.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	4.	2916.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	10.	9132.	4.
0.	0.	0.	16.	2240.	1.	0.	0.	0.	13.	5449.	4.
0.	0.	0.	22.	2616.	1.	42.	14536.	3.	46.	33858.	21.
22.	5363.	9.	97.	29801.	3.	437.	161857.	43.	331.	160378.	101.
66.	30683.	30.	111.	13350.	2.	1009.	412526.	93.	797.	376695.	236.
72.	29984.	38.	32.	18380.	3.	1225.	475688.	109.	868.	362956.	272.
86.	40080.	40.	108.	34453.	4.	1265.	542632.	108.	916.	348892.	285.
84.	29427.	36.	105.	38971.	4.	1236.	522391.	97.	928.	429742.	292.
101.	28810.	41.	88.	37236.	2.	1401.	650876.	112.	893.	349900.	264.
73.	35377.	35.	85.	38595.	4.	1415.	585755.	131.	848.	369715.	279.
79.	38932.	38.	114.	57654.	4.	1215.	648815.	108.	552.	458611.	294.
96.	35155.	43.	81.	22235.	4.	1247.	608726.	113.	1050.	447212.	299.
102.	63565.	50.	146.	43846.	3.	1251.	549030.	98.	654.	337750.	222.
40.	11958.	19.	65.	35832.	4.	849.	312435.	77.	404.	154520.	127.
21.	13457.	12.	34.	51300.	1.	491.	213904.	41.	276.	163884.	92.
10.	2375.	4.	0.	0.	0.	240.	96275.	18.	160.	56872.	51.
0.	0.	0.	0.	0.	0.	9.	4599.	2.	33.	11226.	9.
0.	0.	0.	0.	0.	0.	0.	0.	0.	4.	432.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
849.	365167.	395.	1101.	426911.	40.	13330.	5800245.	1153.	9191.	4083059.	2855.
2.	924.	0.	28.	10673.	0.	12.	5031.	0.	3.	1430.	0.

EXHIBIT 2-16c

ALL SITES
AS RECEIVED QUANTITIES OF REFUSE BY TYPE OF VEHICLE AND BY HOURS OF THE DAY, FOR ALL DAYS
COMPUTER PROGRAM D

	AUTO			OTHER	
CU YDS	POUNDS	# VEHICLES	CU YDS	POUNDS	# VEHICLES
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
1.	605.	4.	0.	0.	0.
13.	3871.	31.	16.	6669.	1.
42.	11661.	128.	17.	10547.	3.
73.	15560.	210.	60.	34595.	11.
93.	28145.	264.	30.	4278.	6.
91.	27853.	259.	49.	26766.	8.
98.	28108.	249.	88.	29698.	11.
90.	22083.	281.	47.	39768.	9.
109.	35132.	285.	56.	30896.	10.
104.	28331.	285.	6.	1770.	1.
95.	26542.	284.	34.	62682.	1.
40.	16366.	113.	0.	0.	0.
40.	13466.	111.	34.	20473.	1.
12.	3447.	51.	0.	25.	1.
1.	96.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
903.	261267.	2556.	437.	268567.	63.
0.	102.	0.	7.	4263.	0.

EXHIBIT 2-18b

WEST DES MOINES SITE
QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM E

WDM MATL CLASS	MATL RECEIVED				COMPACT FACTOR	COMPACTED		SEASONAL ADJUSTMENTS					
	CU YDS	% CY	POUNDS	% LBS		CU YDS	% CY	FACTOR	COMP CY	% CY	POUNDS	% LBS	CUBIC YDS
1.	45.	1.3	107592.	4.9	0.8	36.	2.4	0.6	22.	1.9	64555.	4.2	26.9
2.	298.	8.6	178836.	8.1	0.7	209.	13.9	0.6	125.	11.3	107302.	6.9	178.8
3.	313.	9.2	776300.	35.0	0.8	256.	17.1	0.6	153.	13.9	465780.	30.0	191.7
4.	0.	0.0	1118.	0.1	0.6	0.	0.0	0.6	0.	0.0	671.	0.0	0.3
5.	22.	0.6	55270.	2.5	0.7	15.	1.0	0.6	9.	0.8	33162.	2.1	13.0
6.	114.	3.3	185166.	8.3	0.7	80.	5.3	0.6	48.	4.3	111100.	7.2	68.6
7.	25.	0.7	56557.	2.5	0.9	22.	1.5	0.7	15.	1.4	39590.	2.6	17.2
10.	254.	7.3	171497.	7.7	0.5	127.	8.5	0.9	114.	10.3	154347.	10.0	228.7
11.	179.	5.2	121119.	5.5	0.5	90.	6.0	0.9	81.	7.3	109007.	7.0	161.5
12.	17.	0.5	5520.	0.2	0.4	7.	0.5	0.6	4.	0.4	3312.	0.2	10.3
13.	830.	23.9	224175.	10.1	0.3	249.	16.6	0.6	149.	13.5	134505.	8.7	498.2
14.	17.	0.5	900.	0.0	0.1	2.	0.1	0.6	1.	0.1	540.	0.0	10.0
15.	110.	3.2	14907.	0.7	0.2	22.	1.5	0.6	13.	1.2	8944.	0.6	66.3
20.	0.	0.0	605.	0.0	0.8	0.	0.0	1.0	0.	0.0	605.	0.0	0.3
21.	1.	0.0	545.	0.0	0.6	0.	0.0	1.5	0.	0.0	817.	0.1	0.7
25.	1.	0.0	570.	0.0	0.2	0.	0.0	1.0	0.	0.0	570.	0.0	1.4
26.	12.	0.4	4958.	0.2	0.2	2.	0.2	1.0	2.	0.2	4958.	0.3	12.4
30.	0.	0.0	136.	0.0	0.8	0.	0.0	1.0	0.	0.0	136.	0.0	0.1
35.	10.	0.3	12139.	0.5	0.9	9.	0.6	2.0	18.	1.6	24278.	1.6	19.9
36.	0.	0.0	216.	0.0	1.0	0.	0.0	1.0	0.	0.0	216.	0.0	0.1
40.	295.	8.5	79662.	3.6	0.3	143.	9.5	0.9	129.	11.6	71696.	4.6	265.5
41.	33.	0.9	5497.	0.2	0.3	10.	0.7	0.9	9.	0.8	4947.	0.3	29.6
42.	113.	3.3	15848.	0.7	0.2	23.	1.5	0.9	20.	1.8	14263.	0.9	101.9
43.	246.	7.1	36854.	1.7	0.2	53.	3.5	0.9	47.	4.3	33169.	2.1	221.8
44.	3.	0.1	2155.	0.1	0.7	2.	0.1	1.0	2.	0.2	2155.	0.1	2.7
50.	349.	10.1	50599.	2.3	0.2	84.	5.6	1.0	84.	7.6	50599.	3.3	349.5
51.	27.	0.8	4264.	0.2	0.2	5.	0.4	1.0	5.	0.5	4264.	0.3	26.6
52.	33.	1.0	2668.	0.1	0.2	7.	0.4	1.0	7.	0.6	2668.	0.2	33.3
53.	15.	0.4	1170.	0.1	0.2	3.	0.2	1.0	3.	0.3	1170.	0.1	14.6
54.	15.	0.4	4521.	0.2	0.2	3.	0.2	1.0	3.	0.3	4521.	0.3	15.1
55.	3.	0.1	13081.	0.6	0.9	3.	0.2	1.0	3.	0.3	13081.	0.8	3.2
56.	47.	1.3	63052.	2.8	0.3	14.	0.9	1.0	14.	1.3	63052.	4.1	46.7
57.	29.	0.8	8727.	0.4	0.5	15.	1.0	1.0	15.	1.3	8727.	0.6	29.1
58.	2.	0.0	1179.	0.1	0.9	2.	0.1	1.0	2.	0.1	1179.	0.1	1.7
61.	1.	0.0	319.	0.0	0.2	0.	0.0	1.0	0.	0.0	319.	0.0	0.6
62.	2.	0.1	2398.	0.1	0.9	2.	0.1	1.0	2.	0.2	2398.	0.2	2.2
64.	1.	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.	0.0	0.0
73.	5.	0.1	8000.	0.4	0.9	4.	0.3	1.0	4.	0.4	8000.	0.5	5.0
TOTALS	3475.	0.0	2218120.	0.0	0.0	1499.	0.0	0.0	1106.	0.0	1550603.	0.0	2656.

EXHIBIT 2-19

POLK COUNTY SITE
QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM E

POLK CO

MATL CLASS	MATL RECEIVED CU YDS				COMPACT FACTOR	COMPACTED CU YDS		SEASONAL ADJUSTMENTS FACTOR					
	CU YDS	% CY	POUNDS	% LBS		CU YDS	% CY	FACTOR	COMP CY	% CY	POUNDS	% LBS	CUBIC YDS
1.	5.	0.7	11424.	3.1	0.8	4.	1.4	0.6	2.	1.0	6854.	2.1	2.9
2.	7.	1.0	4164.	1.1	0.7	5.	1.8	0.6	3.	1.2	2498.	0.8	4.2
6.	0.	0.0	81.	0.0	0.7	0.	0.0	0.6	0.	0.0	49.	0.0	0.0
10.	209.	29.1	140866.	37.8	0.5	104.	37.6	0.9	94.	40.2	126779.	38.7	187.8
11.	109.	15.1	73261.	19.7	0.5	54.	19.6	0.9	49.	20.9	65935.	20.1	97.7
12.	21.	3.0	6816.	1.8	0.4	9.	3.1	0.6	5.	2.2	4090.	1.2	12.8
13.	210.	29.4	56828.	15.2	0.3	63.	22.8	0.6	38.	16.2	34097.	10.4	126.3
14.	39.	5.5	2130.	0.6	0.1	4.	1.4	0.6	2.	1.0	1278.	0.4	23.7
15.	0.	0.1	49.	0.0	0.2	0.	0.0	0.6	0.	0.0	29.	0.0	0.2
21.	6.	0.8	6267.	1.7	0.6	3.	1.2	1.5	5.	2.2	9401.	2.9	8.6
26.	1.	0.2	440.	0.1	0.2	0.	0.1	1.0	0.	0.1	440.	0.1	1.1
35.	5.	0.7	6307.	1.7	0.9	5.	1.7	2.0	9.	4.0	12615.	3.9	10.3
40.	5.	0.7	893.	0.2	0.3	2.	0.6	0.9	1.	0.6	804.	0.2	4.8
42.	27.	3.7	3744.	1.0	0.2	5.	1.9	0.9	5.	2.1	3369.	1.0	24.1
43.	4.	0.6	559.	0.1	0.2	1.	0.3	0.9	1.	0.3	503.	0.2	3.6
50.	4.	0.5	425.	0.1	0.2	1.	0.3	1.0	1.	0.3	425.	0.1	3.5
51.	12.	1.7	1915.	0.5	0.2	2.	0.9	1.0	2.	1.0	1915.	0.6	12.0
52.	7.	1.0	590.	0.2	0.2	1.	0.5	1.0	1.	0.6	590.	0.2	7.4
54.	3.	0.4	930.	0.2	0.2	1.	0.2	1.0	1.	0.3	930.	0.3	3.1
55.	2.	0.2	6075.	1.6	0.9	1.	0.5	1.0	1.	0.6	6075.	1.9	1.5
56.	33.	4.7	45124.	12.1	0.3	10.	3.6	1.0	10.	4.3	45124.	13.8	33.4
57.	0.	0.0	22.	0.0	0.5	0.	0.0	1.0	0.	0.0	22.	0.0	0.1
58.	0.	0.1	315.	0.1	0.9	0.	0.1	1.0	0.	0.2	315.	0.1	0.4
61.	7.	0.9	3510.	0.9	0.2	1.	0.5	1.0	1.	0.6	3510.	1.1	6.5
TOTALS	717.	0.0	372736.	0.0	0.0	277.	0.0	0.0	233.	0.0	327648.	0.0	576.

EXHIBIT 2-20

ANKENY SITE
QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM E

ANK MATL	MATL RECEIVED				COMPACT	COMPACTED		SEASONAL ADJUSTMENTS					
CLASS	CU YDS	% CY	POUNDS	% LBS	FACTOR	CU YDS	% CY	FACTOR	COMP CY	% CY	POUNDS	% LBS	CUBIC YDS
1.	0.	0.0	720.	0.2	0.8	0.	0.1	0.6	0.	0.0	432.	0.1	0.2
2.	13.	1.4	7602.	1.8	0.7	9.	2.3	0.6	5.	1.6	4561.	1.3	7.6
3.	4.	0.5	10206.	2.5	0.8	3.	0.9	0.6	2.	0.6	6124.	1.8	2.5
4.	3.	0.3	6561.	1.6	0.6	2.	0.4	0.6	1.	0.3	3937.	1.1	1.6
5.	16.	1.7	40922.	9.8	0.7	11.	3.0	0.6	7.	2.0	24553.	7.1	9.6
6.	43.	4.7	70316.	16.9	0.7	30.	8.0	0.6	18.	5.5	42190.	12.2	26.0
10.	0.	0.0	209.	0.1	0.5	0.	0.0	0.9	0.	0.0	188.	0.1	0.3
11.	0.	0.0	108.	0.0	0.5	0.	0.0	0.9	0.	0.0	97.	0.0	0.1
13.	18.	2.0	4973.	1.2	0.3	6.	1.5	0.6	3.	1.0	2984.	0.9	11.1
14.	3.	0.3	154.	0.0	0.1	0.	0.1	0.6	0.	0.1	93.	0.0	1.7
15.	18.	1.9	2412.	0.6	0.2	4.	0.9	0.6	2.	0.6	1447.	0.4	10.7
26.	9.	0.9	3452.	0.8	0.2	2.	0.5	1.0	2.	0.5	3452.	1.0	8.6
40.	335.	36.2	104095.	25.0	0.3	187.	49.3	0.9	168.	50.5	93686.	27.0	301.8
42.	10.	1.1	1388.	0.3	0.2	2.	0.5	0.9	2.	0.5	1249.	0.4	8.9
43.	53.	5.7	7416.	1.8	0.2	11.	2.8	0.9	10.	2.9	6675.	1.9	47.7
44.	0.	0.0	81.	0.0	0.7	0.	0.0	1.0	0.	0.0	81.	0.0	0.1
45.	7.	0.8	5832.	1.4	0.7	5.	1.3	1.0	5.	1.5	5832.	1.7	7.2
50.	259.	28.0	31048.	7.5	0.2	52.	13.6	1.0	52.	15.5	31048.	8.9	258.7
51.	8.	0.9	1350.	0.3	0.2	2.	0.4	1.0	2.	0.5	1350.	0.4	8.4
52.	15.	1.6	1175.	0.3	0.2	3.	0.8	1.0	3.	0.9	1175.	0.3	14.7
53.	1.	0.1	56.	0.0	0.2	0.	0.0	1.0	0.	0.0	56.	0.0	0.7
54.	9.	1.0	2728.	0.7	0.2	2.	0.5	1.0	2.	0.5	2728.	0.8	9.1
55.	16.	1.7	64597.	15.5	0.9	14.	3.8	1.0	14.	4.3	64597.	18.6	15.9
56.	14.	1.5	18657.	4.5	0.3	4.	1.1	1.0	4.	1.2	18657.	5.4	13.8
57.	51.	5.5	15361.	3.7	0.5	26.	6.8	1.0	26.	7.7	15361.	4.4	51.2
58.	2.	0.2	1442.	0.3	0.9	2.	0.5	1.0	2.	0.6	1442.	0.4	2.1
60.	1.	0.1	156.	0.0	0.3	0.	0.1	1.0	0.	0.1	156.	0.0	0.7
61.	14.	1.5	7409.	1.8	0.2	3.	0.7	1.0	3.	0.8	7409.	2.1	13.7
63.	3.	0.4	5346.	1.3	0.1	0.	0.1	1.0	0.	0.1	5346.	1.5	3.3
TOTALS	925.	0.0	415775.	0.0	0.0	379.	0.0	0.0	333.	0.0	346906.	0.0	838.

EXHIBIT 2-21

EUCLID SITE
QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM E

EUCLID MATL	MATL RECEIVED				COMPACT	COMPACTED		SEASONAL ADJUSTMENTS					
CLASS	CU YDS	% CY	POUNDS	% LBS	FACTOR	CU YDS	% CY	FACTOR	COMP CY	% CY	POUNDS	% LBS	CUBIC YDS
1.	40.	1.0	97200.	5.4	0.8	32.	2.3	0.6	19.	1.8	58320.	4.4	24.3
2.	354.	8.4	212397.	11.9	0.7	248.	17.7	0.6	149.	13.7	127438.	9.5	212.4
3.	99.	2.3	239367.	13.4	0.8	79.	5.6	0.6	47.	4.4	143620.	10.8	59.1
4.	6.	0.1	14592.	0.8	0.6	4.	0.3	0.6	2.	0.2	8755.	0.7	3.6
5.	61.	1.4	156595.	8.7	0.7	43.	3.1	0.6	26.	2.4	93957.	7.0	36.7
6.	123.	2.9	199641.	11.2	0.7	86.	6.2	0.6	52.	4.8	119784.	9.0	73.9
10.	35.	0.8	23493.	1.3	0.5	17.	1.2	0.9	16.	1.4	21144.	1.6	31.3
11.	9.	0.2	6412.	0.4	0.5	5.	0.3	0.9	4.	0.4	5771.	0.4	8.5
12.	6.	0.1	1946.	0.1	0.4	2.	0.2	0.6	1.	0.1	1167.	0.1	3.6
13.	632.	14.9	170564.	9.5	0.3	190.	13.6	0.6	114.	10.5	102339.	7.7	379.0
14.	112.	2.6	6049.	0.3	0.1	11.	0.8	0.6	7.	0.6	3629.	0.3	67.2
15.	224.	5.3	30336.	1.7	0.2	45.	3.2	0.6	27.	2.5	18202.	1.4	134.6
20.	1.	0.0	2491.	0.1	0.8	1.	0.1	1.0	1.	0.1	2491.	0.2	1.4
21.	4.	0.1	4142.	0.2	0.6	2.	0.2	1.5	3.	0.3	6213.	0.5	5.7
25.	2.	0.0	830.	0.0	0.2	0.	0.0	1.0	0.	0.0	830.	0.1	2.1
26.	62.	1.5	24864.	1.4	0.2	12.	0.9	1.0	12.	1.1	24864.	1.9	62.2
30.	0.	0.0	130.	0.0	0.8	0.	0.0	1.0	0.	0.0	130.	0.0	0.1
35.	13.	0.3	15542.	0.9	0.9	11.	0.8	2.0	23.	2.1	31083.	2.3	25.5
36.	1.	0.0	2808.	0.2	1.0	1.	0.1	1.0	1.	0.1	2808.	0.2	1.3
40.	32.	0.8	9736.	0.5	0.3	17.	1.3	0.9	16.	1.5	8762.	0.7	29.1
41.	21.	0.5	10271.	0.6	0.3	18.	1.3	0.9	17.	1.5	9243.	0.7	18.4
42.	53.	1.3	11074.	0.6	0.2	16.	1.1	0.9	14.	1.3	9967.	0.7	47.8
43.	967.	22.8	149253.	8.3	0.2	213.	15.3	0.9	192.	17.7	134328.	10.1	870.4
44.	59.	1.4	47413.	2.6	0.7	41.	2.9	1.0	41.	3.8	47413.	3.6	58.5
45.	11.	0.3	8626.	0.5	0.7	7.	0.5	1.0	7.	0.7	8626.	0.6	10.6
50.	780.	18.4	93646.	5.2	0.2	156.	11.2	1.0	156.	14.4	93646.	7.0	780.4
51.	99.	2.3	15784.	0.9	0.2	20.	1.4	1.0	20.	1.8	15784.	1.2	98.7
52.	146.	3.4	11677.	0.7	0.2	29.	2.1	1.0	29.	2.7	11677.	0.9	146.0
53.	27.	0.6	2137.	0.1	0.2	5.	0.4	1.0	5.	0.5	2137.	0.2	26.7
54.	87.	2.1	26146.	1.5	0.2	17.	1.2	1.0	17.	1.6	26146.	2.0	87.2
55.	7.	0.2	29241.	1.6	0.9	6.	0.5	1.0	6.	0.6	29241.	2.2	7.2
56.	99.	2.3	133542.	7.5	0.3	30.	2.1	1.0	30.	2.7	133542.	10.0	98.9
57.	20.	0.5	6102.	0.3	0.5	10.	0.7	1.0	10.	0.9	6102.	0.5	20.3
58.	6.	0.1	4389.	0.2	0.9	6.	0.4	1.0	6.	0.5	4389.	0.3	6.3
60.	10.	0.2	2160.	0.1	0.3	3.	0.2	1.0	3.	0.3	2160.	0.2	10.0
61.	20.	0.5	10759.	0.6	0.2	4.	0.3	1.0	4.	0.4	10759.	0.8	19.9
62.	2.	0.1	2511.	0.1	0.9	2.	0.1	1.0	2.	0.2	2511.	0.2	2.3
70.	3.	0.1	5862.	0.3	0.9	3.	0.2	1.0	3.	0.3	5862.	0.4	3.3
73.	0.	0.0	224.	0.0	0.9	0.	0.0	1.0	0.	0.0	224.	0.0	0.1
TOTALS	4235.	0.0	1789956.	0.0	0.0	1396.	0.0	0.0	1084.	0.0	1335069.	0.0	3475.

EXHIBIT 2-22

DES MOINES SITE #1
QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM E

DM1

MATL		MATL RECEIVED			COMPACT	COMPACTED			SEASONAL ADJUSTMENTS				
CLASS	CU YDS	% CY	POUNDS	% LBS	FACTOR	CU YDS	% CY	FACTOR	COMP CY	% CY	POUNDS	% LBS	CUBIC YDS
1.	121.	0.6	291108.	3.7	0.8	97.	1.1	0.6	58.	0.8	174665.	2.6	72.5
2.	447.	2.2	274749.	3.5	0.7	321.	3.8	0.6	192.	2.5	164849.	2.4	268.2
3.	83.	0.4	257957.	3.3	0.8	85.	1.0	0.6	51.	0.7	154774.	2.3	49.9
4.	6.	0.0	14580.	0.2	0.6	4.	0.0	0.6	2.	0.0	8748.	0.1	3.6
5.	47.	0.2	119923.	1.5	0.7	33.	0.4	0.6	20.	0.3	71954.	1.1	28.1
6.	339.	1.7	559135.	7.2	0.7	242.	2.8	0.6	145.	1.9	335481.	4.9	203.5
7.	53.	0.3	122797.	1.6	0.9	48.	0.6	0.7	34.	0.4	85958.	1.3	37.4
10.	9.	0.0	6412.	0.1	0.5	5.	0.1	0.9	4.	0.1	5771.	0.1	8.5
11.	17.	0.1	11745.	0.2	0.5	9.	0.1	0.9	8.	0.1	10570.	0.2	15.7
12.	7.	0.0	2336.	0.0	0.4	3.	0.0	0.6	2.	0.0	1402.	0.0	4.4
13.	386.	1.9	104246.	1.3	0.3	116.	1.4	0.6	69.	0.9	62547.	0.9	231.7
14.	64.	0.3	4095.	0.1	0.1	8.	0.1	0.6	5.	0.1	2457.	0.0	38.3
15.	118.	0.6	15915.	0.2	0.2	24.	0.3	0.6	14.	0.2	9549.	0.1	70.7
20.	53.	0.3	22663C.	2.9	0.8	105.	1.2	1.0	105.	1.4	226630.	3.3	52.9
21.	75.	0.4	146632.	1.9	0.6	81.	0.9	1.5	121.	1.6	219948.	3.2	111.8
22.	19.	0.1	33043.	0.4	0.8	15.	0.2	1.0	15.	0.2	33043.	0.5	19.1
25.	6.	0.0	5004.	0.1	0.2	3.	0.0	1.0	3.	0.0	5004.	0.1	6.1
26.	82.	0.4	47828.	0.6	0.2	24.	0.3	1.0	24.	0.3	47828.	0.7	82.2
27.	18.	0.1	54360.	0.7	0.3	11.	0.1	1.0	11.	0.1	54360.	0.8	18.2
28.	62.	0.3	295002.	3.8	0.1	18.	0.2	0.8	15.	0.2	236002.	3.5	49.7
30.	101.	0.5	186114.	2.4	0.8	115.	1.3	1.0	115.	1.5	186114.	2.7	101.2
32.	106.	0.5	57056.	0.7	~~0.6~~	63.	0.7	1.0	63.	0.8	57056.	0.8	105.7
33.	22.	0.1	21232.	0.3	0.5	11.	0.1	0.8	9.	0.1	16986.	0.2	17.9
35.	1C.	0.0	12224.	0.2	0.9	9.	0.1	2.0	18.	0.2	24449.	0.4	20.0
36.	2.	0.0	3888.	0.0	1.0	2.	0.0	1.0	2.	0.0	3888.	0.1	1.8
38.	0.	0.0	267.	0.0	0.9	0.	0.0	1.0	0.	0.0	267.	0.0	0.2
40.	2968.	14.5	1385819.	17.8	0.3	2489.	29.2	0.9	2241.	29.0	1247237.	18.3	2670.8
41.	213.	1.0	70649.	0.9	0.3	127.	1.5	0.9	114.	1.5	63584.	0.9	191.3
42.	2787.	13.6	793404.	10.2	0.2	1133.	13.3	0.9	1020.	13.2	714064.	10.5	2508.5
43.	3324.	16.3	589674.	7.6	0.2	842.	9.9	0.9	758.	9.8	530706.	7.8	2991.8
44.	134.	0.7	108904.	1.4	0.7	94.	1.1	1.0	94.	1.2	108904.	1.6	134.4
45.	62.	0.3	50265.	0.6	0.7	43.	0.5	1.0	43.	0.6	50265.	0.7	62.1
50.	7527.	36.8	1096426.	14.1	0.2	1827.	21.5	1.0	1827.	23.7	1096426.	16.1	7527.2
51.	184.	0.9	37391.	0.5	0.2	47.	0.5	1.0	47.	0.6	37391.	0.5	183.7
52.	265.	1.3	21239.	0.3	0.2	53.	0.6	1.0	53.	0.7	21239.	0.3	265.5
53.	46.	0.2	3698.	0.0	0.2	9.	0.1	1.0	9.	0.1	3698.	0.1	46.2
54.	52.	0.3	15723.	0.2	0.2	10.	0.1	1.0	10.	0.1	15723.	0.2	52.4
55.	48.	0.2	193104.	2.5	0.9	43.	0.5	1.0	43.	0.6	193104.	2.8	47.7
56.	162.	0.8	259474.	3.3	0.3	58.	0.7	1.0	58.	0.7	259474.	3.8	162.2
57.	284.	1.4	85243.	1.1	0.5	142.	1.7	1.0	142.	1.8	85243.	1.2	284.1
58.	67.	0.3	61222.	0.8	0.9	79.	0.9	1.0	79.	1.0	61222.	0.9	66.7
60.	4.	0.0	950.	0.0	0.3	1.	0.0	1.0	1.	0.0	950.	0.0	4.4
61.	18.	0.1	962C.	0.1	0.2	4.	0.0	1.0	4.	0.0	9620.	0.1	17.8
62.	24.	0.1	77760.	1.0	0.9	65.	0.8	1.0	65.	0.8	77760.	1.1	24.0
63.	23.	0.1	47668.	0.6	0.1	3.	0.0	1.0	3.	0.0	47668.	0.7	23.4
64.	4.	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.	0.0	0.0
TOTALS	20452.	0.0	7782517.	0.0	0.0	8519.	0.0	0.0	7715.	0.0	6824581.	0.0	18883.

EXHIBIT 2-23

DES MOINES SITE #2
QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM E

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DM2
 MATL           MATL RECEIVED                      COMPACT   COMPACTED                        SEASONAL ADJUSTMENTS
CLASS   CU YDS   % CY    POUNDS   % LBS            FACTOR   CU YDS   % CY        FACTOR  COMP CY   % CY    POUNDS   % LBS   CUBIC YDS
   1.     505.    3.0  1211772.   12.3               0.8      404.    5.6          0.6     242.    4.7   727063.   10.4      302.9
   2.    2269.   13.6  1361580.   13.8               0.7     1589.   21.9          0.6     953.   18.5   816948.   11.7     1361.6
   3.     527.    3.2  1281813.   13.0               0.8      422.    5.8          0.6     253.    4.9   769087.   11.0      316.5
   4.       1.    0.0     1822.    0.C               0.6        0.    0.0          0.6       0.    0.0     1093.    0.0        0.4
   5.     169.    1.0   431949.    4.4               0.7      118.    1.6          0.6      71.    1.4   259169.    3.7      101.2
   6.     273.    1.6   442689.    4.5               0.7      191.    2.6          0.6     115.    2.2   265613.    3.8      164.0
   7.       5.    0.0    10637.    0.1               0.9        4.    0.1          0.7       3.    0.1     7446.    0.1        3.2
  1C.    2333.   14.0  1574826.   16.0               0.5     1167.   16.1          0.9    1050.   20.4  1417343.   20.3     2099.8
  11.    1153.    6.9   778589.    7.9               0.5      577.    7.9          0.9     519.   10.1   700730.   10.1     1038.1
  12.     268.    1.6    85763.    0.9               0.4      107.    1.5          0.6      64.    1.3    51458.    0.7      160.8
  13.    6441.   38.6  1738974.   17.6               0.3     1932.   26.6          0.6    1159.   22.5  1043384.   15.0     3864.4
  14.     263.    1.6    14194.    0.1               0.1       26.    0.4          0.6      16.    0.3     8516.    0.1      157.7
  15.      88.    0.5    11842.    0.1               0.2       18.    0.2          0.6      11.    0.2     7105.    0.1       52.6
  20.       3.    0.0     5536.    0.1               0.8        3.    0.0          1.0       3.    0.0     5536.    0.1        3.2
  21.       1.    0.0     1144.    0.0               0.6        1.    0.0          1.5       1.    0.0     1717.    0.0        1.6
  22.       2.    0.0     3633.    0.0               0.8        2.    0.0          1.0       2.    0.0     3633.    0.1        2.1
  25.     101.    0.6    40388.    0.4               0.2       20.    0.3          1.0      20.    0.4    40388.    0.6      101.0
  26.     240.    1.4    95836.    1.0               0.2       48.    0.7          1.0      48.    0.9    95836.    1.4      239.6
  28.       2.    0.0     2916.    0.0               0.1        0.    0.0          0.8       0.    0.0     2333.    0.0        1.4
  32.       0.    0.0       54.    0.0               0.6        0.    0.0          1.0       0.    0.0       54.    0.0        0.1
  33.       1.    0.0     1330.    0.C               0.5        1.    0.0          0.8       1.    0.0     1064.    0.0        1.1
  40.       8.    0.0     2635.    0.0               0.3        5.    0.1          0.9       4.    0.1     2372.    0.0        7.0
  42.      51.    0.3     7161.    0.1               0.2       10.    0.1          0.9       9.    0.2     6445.    0.1       46.0
  43.     819.    4.9   114607.    1.2               0.2      164.    2.3          0.9     147.    2.9   103146.    1.5      736.8
  44.      92.    0.6    74374.    0.8               0.7       64.    0.9          1.0      64.    1.2    74374.    1.1       91.8
  45.       6.    0.0     5062.    0.1               0.7        4.    0.1          1.0       4.    0.1     5062.    0.1        6.2
  50.     137.    0.8    16449.    0.2               0.2       27.    0.4          1.0      27.    0.5    16449.    0.2      137.1
  51.      51.    0.3     8154.    0.1               0.2       10.    0.1          1.0      10.    0.2     8154.    0.1       51.0
  52.     174.    1.0    13912.    0.1               0.2       35.    0.5          1.0      35.    0.7    13912.    0.2      173.9
  53.      27.    0.2     2122.    0.0               0.2        5.    0.1          1.0       5.    0.1     2122.    0.0       26.5
  54.     109.    0.7    32823.    0.3               0.2       22.    0.3          1.0      22.    0.4    32823.    0.5      109.4
  55.      41.    0.2   167933.    1.7               0.9       37.    0.5          1.0      37.    0.7   167933.    2.4       41.5
  56.     112.    0.7   150869.    1.5               0.3       34.    0.5          1.0      34.    0.7   150869.    2.2      111.8
  57.     341.    2.0   102187.    1.0               0.5      170.    2.3          1.0     170.    3.3   102187.    1.5      340.6
  58.      14.    0.1     9534.    0.1               0.9       12.    0.2          1.0      12.    0.2     9534.    0.1       13.6
  59.      36.    0.2    43440.    0.4               0.8       29.    0.4          1.0      29.    0.6    43440.    0.6       36.2
  60.       1.    0.0      190.    0.0               0.3        0.    0.0          1.0       0.    0.0      190.    0.0        0.9
  61.      14.    0.1     7625.    0.1               0.2        3.    0.0          1.0       3.    0.1     7625.    0.1       14.1


TOTALS  16677.    0.0  9856367.    0.C               0.0     7261.    0.0          0.0    5145.    0.0  6972155.    0.0     11918.
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EXHIBIT 2-24

ALL SITES

QUANTITY OF REFUSE AND ADJUSTMENT FACTORS BY MATERIAL CLASSIFICATION, FOR ALL DAYS

COMPUTER PROGRAM E

ENTIRE STUDY

MATL	MATL RECEIVED				COMPACT	COMPACTED		SEASONAL ADJUSTMENTS					
CLASS	CU YDS	% CY	POUNDS	% LBS	FACTOR	CU YDS	% CY	FACTOR	COMP CY	% CY	POUNDS	% LBS	CUBIC YDS
1.	724.	1.5	1739352.	7.6	0.8	580.	2.9	0.6	348.	2.2	1043611.	5.9	434.6
2.	3523.	7.4	2120496.	9.2	0.7	2474.	12.6	0.6	1484.	9.3	1272297.	7.2	2113.9
3.	1104.	2.3	2738804.	11.9	0.8	902.	4.6	0.6	541.	3.4	1643282.	9.3	662.4
4.	16.	0.0	38673.	0.2	0.6	10.	0.0	0.6	6.	0.0	23204.	0.1	9.5
5.	315.	0.7	806195.	3.5	0.7	220.	1.1	0.6	132.	0.8	483717.	2.7	189.0
6.	894.	1.9	1458486.	6.4	0.7	630.	3.2	0.6	378.	2.4	875091.	4.9	536.6
7.	83.	0.2	189991.	0.8	0.9	74.	0.4	0.7	52.	0.3	132994.	0.8	57.8
10.	3001.	6.3	2025702.	8.8	0.5	1501.	7.6	0.9	1350.	8.5	1823131.	10.3	2700.9
11.	1515.	3.2	1022743.	4.5	0.5	758.	3.8	0.9	682.	4.3	920468.	5.2	1363.7
12.	325.	0.7	103900.	0.5	0.4	130.	0.7	0.6	78.	0.5	62340.	0.4	194.8
13.	8833.	18.7	2384793.	10.4	0.3	2650.	13.4	0.6	1590.	10.0	1430875.	8.1	5299.5
14.	555.	1.2	30620.	0.1	0.1	57.	0.3	0.6	34.	0.2	18372.	0.1	333.0
15.	560.	1.2	75696.	0.3	0.2	112.	0.6	0.6	67.	0.4	45417.	0.3	336.2
20.	58.	0.1	235263.	1.0	0.8	109.	0.6	1.0	109.	0.7	235263.	1.3	57.9
21.	86.	0.2	158731.	0.7	0.6	87.	0.4	1.5	131.	0.8	238097.	1.3	128.4
22.	21.	0.0	36676.	0.2	0.8	17.	0.1	1.0	17.	0.1	36676.	0.2	21.2
25.	125.	0.3	52472.	0.2	0.2	26.	0.1	1.0	26.	0.2	52472.	0.3	124.8
26.	419.	0.9	182644.	0.8	0.2	91.	0.5	1.0	91.	0.6	182644.	1.0	419.2
27.	18.	0.0	54360.	0.2	0.3	11.	0.1	1.0	11.	0.1	54360.	0.3	18.2
28.	64.	0.1	297918.	1.3	0.1	18.	0.1	0.8	15.	0.1	238334.	1.3	51.1
30.	101.	0.2	186381.	0.8	0.8	115.	0.6	1.0	115.	0.7	186381.	1.1	101.4
32.	106.	0.2	57110.	0.2	0.6	63.	0.3	1.0	63.	0.4	57110.	0.3	105.8
33.	24.	0.1	22562.	0.1	0.5	12.	0.1	0.8	9.	0.1	18050.	0.1	19.0
35.	38.	0.1	46212.	0.2	0.9	34.	0.2	2.0	68.	0.4	92425.	0.5	75.8
36.	3.	0.0	6912.	0.0	1.0	3.	0.0	1.0	3.	0.0	6912.	0.0	3.2
38.	0.	0.0	267.	0.0	0.9	0.	0.0	1.0	0.	0.0	267.	0.0	0.2
40.	3643.	7.7	1582842.	6.9	0.3	2843.	14.4	0.9	2559.	16.1	1424557.	8.0	3279.0
41.	266.	0.6	86417.	0.4	0.3	155.	0.8	0.9	140.	0.9	77775.	0.4	239.4
42.	3043.	6.4	832801.	3.6	0.2	1190.	6.0	0.9	1071.	6.7	749521.	4.2	2738.3
43.	5438.	11.5	901806.	3.9	0.2	1288.	6.5	0.9	1159.	7.3	811625.	4.6	4894.2
44.	288.	0.6	233219.	1.0	0.7	202.	1.0	1.0	202.	1.3	233219.	1.3	287.9
45.	86.	0.2	69786.	0.3	0.7	60.	0.3	1.0	60.	0.4	69786.	0.4	86.2
50.	9058.	19.1	1288814.	5.6	0.2	2148.	10.9	1.0	2148.	13.5	1288813.	7.3	9058.2
51.	384.	0.8	69387.	0.3	0.2	87.	0.4	1.0	87.	0.5	69387.	0.4	383.7
52.	641.	1.4	51274.	0.2	0.2	128.	0.7	1.0	128.	0.8	51274.	0.3	640.9
53.	119.	0.3	9511.	0.0	0.2	24.	0.1	1.0	24.	0.1	9511.	0.1	118.9
54.	281.	0.6	84177.	0.4	0.2	56.	0.3	1.0	56.	0.4	84177.	0.5	280.6
55.	117.	0.2	474032.	2.1	0.9	105.	0.5	1.0	105.	0.7	474032.	2.7	117.0
56.	467.	1.0	670718.	2.9	0.3	149.	0.8	1.0	149.	0.9	670718.	3.8	466.8
57.	725.	1.5	217644.	0.9	0.5	363.	1.8	1.0	363.	2.3	217644.	1.2	725.5
58.	91.	0.2	78081.	0.3	0.9	100.	0.5	1.0	100.	0.6	78081.	0.4	90.7
59.	36.	0.1	43440.	0.2	0.8	29.	0.1	1.0	29.	0.2	43440.	0.2	36.2
60.	16.	0.0	3456.	0.0	0.3	5.	0.0	1.0	5.	0.0	3456.	0.0	16.0
61.	73.	0.2	39242.	0.2	0.2	15.	0.1	1.0	15.	0.1	39242.	0.2	72.7
62.	29.	0.1	82669.	0.4	0.9	69.	0.3	1.0	69.	0.4	82669.	0.5	28.5
63.	27.	0.1	53014.	0.2	0.1	3.	0.0	1.0	3.	0.0	53014.	0.3	26.7
64.	5.	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.	0.0	0.0
70.	3.	0.0	5862.	0.0	0.9	3.	0.0	1.0	3.	0.0	5862.	0.0	3.3
73.	5.	0.0	8224.	0.0	0.9	5.	0.0	1.0	5.	0.0	8224.	0.0	5.1
TOTALS	47351.	0.0	22959379.	0.0	0.0	19711.	0.0	0.0	15881.	0.0	17719819.	0.0	38954.

EXHIBIT 2-25

WEST DES MOINES SITE

CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION, FOR ALL DAYS, COMPUTER PROGRAM F

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	TONS	SOUTH CENTROIDS				WEST CENTROIDS			
			CY SUM	CY COORD	LB SUM	LB COORD	CY SUM	CY COORD	LB SUM	LB COORD
1.	0.69	1678.43	3147.	117.	7552142.	117.	2836.	105.	6806381.	105.
2.	4.03	2789.84	20806.	116.	12483699.	116.	18391.	103.	11034784.	103.
3.	4.94	12110.27	22082.	115.	53658901.	115.	19509.	102.	47407932.	102.
4.	0.01	17.44	30.	110.	73454.	110.	27.	97.	65173.	97.
5.	0.29	862.22	1515.	117.	3879412.	117.	1278.	99.	3271879.	99.
6.	1.55	2888.59	7974.	116.	12917195.	116.	7389.	108.	11970516.	108.
7.	0.50	1029.34	1998.	116.	4596226.	116.	1811.	105.	4166437.	105.
10.	3.69	4013.03	26473.	116.	17868947.	116.	23879.	104.	16118139.	104.
11.	2.60	2834.17	18815.	117.	12699862.	117.	17064.	106.	11517983.	106.
12.	0.13	86.11	1209.	117.	386896.	117.	1076.	104.	344196.	104.
13.	4.82	3497.13	57932.	116.	15641635.	116.	52385.	105.	14143923.	105.
14.	0.03	14.04	1150.	115.	62083.	115.	1056.	106.	56998.	106.
15.	0.43	232.54	7679.	116.	1036615.	116.	7016.	106.	947114.	106.
20.	0.01	15.74	41.	117.	70757.	117.	36.	103.	62539.	103.
21.	0.01	21.25	88.	117.	95647.	117.	84.	112.	91560.	112.
25.	0.01	14.82	161.	113.	64410.	113.	152.	107.	60990.	107.
26.	0.08	128.91	1460.	118.	584080.	118.	1284.	104.	513582.	104.
30.	0.00	3.55	12.	117.	15970.	117.	11.	106.	14469.	106.
35.	0.58	631.23	2344.	118.	2859289.	118.	2080.	105.	2537770.	105.
36.	0.00	5.62	12.	118.	25488.	118.	11.	107.	23112.	107.
40.	4.15	1864.10	30993.	117.	8446904.	118.	28606.	108.	7678005.	107.
41.	0.29	128.63	3422.	116.	571552.	116.	3040.	103.	507620.	103.
42.	0.66	370.84	11948.	117.	1672768.	117.	10559.	104.	1478218.	104.
43.	1.53	862.39	25786.	116.	3853444.	116.	23517.	106.	3508315.	106.
44.	0.06	56.02	321.	121.	259921.	121.	285.	107.	231129.	107.
50.	2.72	1315.58	40851.	117.	5902550.	117.	36669.	105.	5294690.	105.
51.	0.17	110.86	3139.	118.	502255.	118.	2812.	106.	449893.	106.
52.	0.21	69.36	3868.	116.	309420.	116.	3517.	105.	281341.	105.
53.	0.09	30.42	1715.	117.	137195.	117.	1572.	107.	125746.	107.
54.	0.10	117.55	1802.	120.	540465.	120.	1547.	103.	464190.	103.
55.	0.09	340.12	360.	111.	1456339.	111.	337.	104.	1363878.	104.
56.	0.45	1639.34	5546.	119.	7487212.	119.	4868.	104.	6571129.	104.
57.	0.47	226.90	3363.	116.	1008930.	116.	2811.	97.	843354.	97.
58.	0.05	30.67	195.	115.	136192.	115.	185.	110.	129745.	110.
61.	0.00	8.28	71.	120.	38232.	120.	61.	104.	33134.	104.
62.	0.06	62.34	253.	114.	273326.	114.	226.	102.	244555.	102.
73.	0.15	208.00	575.	115.	920000.	115.	510.	102.	816000.	102.
TOTALS	35.66	40315.67	309133.	116.	180089414.	116.	278497.	105.	161176417.	104.

EXHIBIT 2-26

POLK COUNTY SITE
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION, FOR ALL DAYS,
COMPUTER PROGRAM F

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	TONS	SOUTH CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD	- WEST CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD
1.	0.07	178.21	200.	70.	480326.	70.	125.	44.	299289.	44.
2.	0.09	64.96	338.	81.	203036.	81.	245.	59.	146722.	59.
6.	0.00	1.26	2.	60.	2916.	60.	2.	74.	3596.	74.
10.	3.03	3296.26	11473.	61.	7743994.	61.	8940.	48.	6034557.	48.
11.	1.57	1714.31	5960.	61.	4022973.	61.	6227.	64.	4203227.	64.
12.	0.16	106.33	703.	55.	224928.	55.	588.	46.	188122.	46.
13.	1.22	886.52	7699.	61.	2078824.	61.	6010.	48.	1622790.	48.
14.	0.08	33.23	1469.	62.	79348.	62.	1808.	76.	97645.	76.
15.	0.00	0.76	17.	80.	2333.	80.	15.	71.	2070.	71.
21.	0.17	244.43	548.	64.	597756.	64.	602.	70.	655880.	70.
26.	0.01	11.44	103.	94.	41360.	94.	85.	77.	33880.	77.
35.	0.30	327.98	891.	86.	1087410.	86.	556.	54.	678003.	54.
40.	0.05	20.91	308.	64.	51384.	64.	309.	64.	51542.	64.
42.	0.16	87.60	1720.	71.	240845.	71.	1496.	62.	209499.	62.
43.	0.02	13.07	261.	73.	36543.	73.	212.	59.	29662.	59.
50.	0.02	11.04	268.	76.	32119.	76.	256.	72.	30751.	72.
51.	0.08	49.80	693.	58.	110942.	58.	855.	71.	136781.	71.
52.	0.05	15.35	543.	74.	43432.	74.	474.	64.	37950.	64.
54.	0.02	24.18	304.	98.	91140.	98.	161.	52.	48360.	52.
55.	0.04	157.95	112.	75.	455625.	75.	108.	72.	437400.	72.
56.	0.32	1173.22	2329.	70.	3144419.	70.	1745.	52.	2355918.	52.
57.	0.00	0.58	6.	77.	1732.	77.	6.	82.	1845.	82.
58.	0.01	8.19	30.	66.	20685.	66.	33.	73.	22890.	73.
61.	0.04	91.26	539.	83.	291330.	83.	377.	58.	203580.	58.
TOTALS	7.52	8518.85	36518.	63.	21085399.	64.	31235.	54.	17531958.	54.

EXHIBIT 2-27

ANKENY SITE
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION, FOR ALL DAYS, COMPUTER PROGRAM F

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	TONS	SOUTH CENTROIDS CY SUM	SOUTH CENTROIDS CY COORD	SOUTH CENTROIDS LB SUM	SOUTH CENTROIDS LB COORD	WEST CENTROIDS CY SUM	WEST CENTROIDS CY COORD	WEST CENTROIDS LB SUM	WEST CENTROIDS LB COORD
1.	0.00	11.23	11.	61.	26352.	61.	14.	80.	34560.	80.
2.	0.17	118.59	482.	63.	289267.	63.	586.	77.	351777.	77.
3.	0.06	159.21	156.	62.	379663.	62.	189.	75.	460145.	75.
4.	0.03	102.35	100.	62.	244069.	62.	118.	73.	287372.	73.
5.	0.22	638.38	583.	61.	1491210.	61.	678.	71.	1736808.	71.
6.	0.59	1096.93	1660.	64.	2688444.	64.	2023.	78.	3277836.	78.
10.	0.00	4.90	17.	61.	11488.	61.	20.	72.	13559.	72.
11.	0.00	2.53	9.	62.	6026.	62.	11.	76.	7387.	76.
13.	0.11	77.59	688.	62.	185655.	62.	834.	75.	225248.	75.
14.	0.01	2.41	107.	63.	5784.	63.	128.	75.	6930.	75.
15.	0.07	37.63	680.	63.	91793.	63.	833.	78.	112482.	78.
26.	0.06	89.75	533.	62.	213332.	62.	622.	72.	248976.	72.
40.	5.42	2435.83	18711.	62.	5808492.	62.	22035.	73.	6839805.	73.
42.	0.06	32.48	555.	62.	77726.	62.	674.	75.	94295.	75.
43.	0.31	173.55	3066.	64.	429281.	64.	3550.	74.	496943.	74.
44.	0.00	2.11	6.	60.	4860.	60.	8.	76.	6156.	76.
45.	0.16	151.63	461.	64.	373248.	64.	576.	80.	466560.	80.
50.	1.67	807.24	16455.	64.	1974551.	64.	20039.	77.	2404727.	77.
51.	0.05	35.11	527.	62.	84250.	62.	617.	73.	98721.	73.
52.	0.09	30.56	924.	63.	73892.	63.	1084.	74.	86717.	74.
53.	0.00	1.46	43.	62.	3448.	62.	55.	78.	4380.	78.
54.	0.06	70.94	565.	62.	169638.	62.	669.	74.	200599.	74.
55.	0.46	1679.53	1008.	63.	4084424.	63.	1231.	77.	4987573.	77.
56.	0.13	485.08	877.	63.	1183666.	63.	1077.	78.	1454516.	78.
57.	0.83	399.40	3316.	65.	994686.	65.	4009.	78.	1202850.	78.
58.	0.06	37.49	129.	63.	90545.	63.	151.	73.	105371.	73.
60.	0.01	4.04	45.	62.	9642.	62.	52.	72.	11197.	72.
61.	0.09	192.63	878.	64.	474163.	64.	1073.	78.	579312.	78.
63.	0.01	139.00	211.	64.	342144.	64.	264.	80.	427680.	80.
TOTALS	10.74	9019.56	52803.	63.	21811737.	63.	63223.	75.	26230483.	76.

EXHIBIT 2-28

EUCLID SITE
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION FOR ALL DAYS, COMPUTER PROGRAM F

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	TONS	SOUTH CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD	WEST CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD
1.	0.63	1516.32	2528.	104.	6067834.	104.	2166.	89.	5198722.	89.
2.	4.79	3313.39	21985.	104.	13191009.	104.	18484.	87.	11090440.	87.
3.	1.52	3734.13	5876.	99.	14279414.	99.	5457.	92.	13260972.	92.
4.	0.07	227.64	363.	101.	882279.	101.	303.	84.	736107.	84.
5.	0.83	2442.88	3648.	99.	9338930.	99.	3199.	87.	8190556.	87.
6.	1.67	3114.39	7396.	100.	11980775.	100.	6563.	89.	10632524.	89.
10.	0.50	549.74	3239.	103.	2186027.	103.	2806.	90.	1894111.	90.
11.	0.14	150.05	894.	105.	603505.	105.	731.	86.	493715.	86.
12.	0.05	30.35	387.	106.	123896.	106.	323.	88.	103275.	88.
13.	3.67	2660.80	38845.	102.	10488106.	102.	33137.	87.	8946887.	87.
14.	0.22	94.37	6731.	100.	363448.	100.	5918.	88.	319586.	88.
15.	0.87	473.25	13623.	101.	1842380.	101.	12128.	90.	1639554.	90.
20.	0.04	64.77	150.	104.	259085.	104.	115.	80.	199296.	80.
21.	0.11	161.54	5427.	952.	5914937.	952.	460.	81.	501291.	81.
25.	0.01	21.58	217.	105.	86850.	105.	161.	77.	64250.	77.
26.	0.40	646.46	6184.	99.	2473575.	99.	5539.	89.	2215597.	89.
30.	0.00	3.38	10.	105.	13650.	105.	10.	100.	13000.	100.
35.	0.74	808.16	2522.	99.	3076939.	99.	2284.	90.	2786640.	90.
36.	0.04	73.01	143.	110.	308880.	110.	112.	86.	241488.	86.
40.	0.51	227.82	2991.	103.	902025.	103.	2717.	93.	864029.	99.
41.	0.54	240.33	2026.	110.	1015201.	110.	1635.	89.	819060.	89.
42.	0.46	259.13	4804.	101.	1010016.	101.	4403.	92.	957171.	96.
43.	6.19	3492.53	88771.	102.	13705454.	102.	78446.	90.	12201470.	91.
44.	1.32	1232.75	5968.	102.	4834188.	102.	5114.	87.	4141990.	87.
45.	0.24	224.29	1039.	98.	841752.	98.	848.	80.	686920.	80.
50.	5.03	2434.80	79917.	102.	9590035.	102.	72911.	93.	8749325.	93.
51.	0.64	410.39	10165.	103.	1626419.	103.	8943.	91.	1430927.	91.
52.	0.94	303.61	15073.	103.	1205876.	103.	12857.	88.	1028535.	88.
53.	0.17	55.56	2753.	103.	220223.	103.	2276.	85.	182058.	85.
54.	0.56	679.81	9074.	104.	2722082.	104.	7531.	86.	2259347.	86.
55.	0.21	760.27	753.	104.	3050580.	104.	630.	87.	2553484.	87.
56.	0.96	3472.09	10117.	102.	13658013.	102.	8341.	84.	11260427.	84.
57.	0.33	158.65	2019.	99.	605736.	99.	1721.	85.	516438.	85.
58.	0.18	114.11	672.	107.	470571.	107.	551.	88.	385896.	88.
60.	0.10	56.16	940.	94.	203040.	94.	750.	75.	162000.	75.
61.	0.13	279.75	2057.	103.	1110564.	103.	1659.	83.	896027.	83.
62.	0.07	65.29	284.	122.	306342.	122.	200.	86.	215946.	86.
70.	0.10	152.42	322.	96.	562800.	96.	275.	82.	480725.	82.
73.	0.00	5.82	14.	99.	22176.	99.	10.	74.	16576.	74.
TOTALS	34.95	34711.79	359926.	104.	141144611.	106.	311716.	90.	118336363.	89.

EXHIBIT 2-29

DES MOINES #1 SITE
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION FOR ALL DAYS
COMPUTER PROGRAM F

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	TONS	SOUTH CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD	WEST CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD
1.	1.88	4541.28	7909.	109.	19041077.	109.	5633.	78.	13562196.	78.
2.	6.20	4286.08	29810.	111.	18277768.	111.	20252.	76.	12439070.	75.
3.	1.64	4024.12	5705.	114.	17739246.	115.	3728.	75.	11483014.	74.
4.	0.07	227.45	414.	115.	1004926.	115.	317.	88.	769168.	88.
5.	0.63	1870.80	3135.	112.	8026319.	112.	2128.	76.	5448152.	76.
6.	4.67	8722.50	22902.	113.	37677987.	112.	16115.	79.	26515242.	79.
7.	1.08	2234.90	4335.	116.	9969986.	116.	2895.	77.	6659408.	77.
10.	0.14	150.05	1011.	118.	682465.	118.	633.	74.	427437.	74.
11.	0.25	274.83	1761.	112.	1188513.	112.	1363.	87.	919907.	87.
12.	0.06	36.44	467.	107.	149376.	107.	326.	74.	104237.	74.
13.	2.24	1626.23	27249.	118.	7357108.	118.	18598.	80.	5021451.	80.
14.	0.15	63.88	4208.	110.	268434.	109.	3133.	82.	210410.	86.
15.	0.46	248.28	8093.	114.	1092505.	114.	5458.	77.	736794.	77.
20.	3.38	5892.38	6383.	121.	27503444.	121.	3022.	57.	12630293.	56.
21.	3.90	5718.66	13476.	121.	26754640.	122.	7989.	71.	14005282.	64.
22.	0.49	859.12	2184.	114.	3779184.	114.	1325.	69.	2292249.	69.
25.	0.08	130.10	652.	107.	550012.	110.	419.	69.	336652.	67.
26.	0.77	1243.53	9254.	113.	5328198.	111.	6163.	75.	3642911.	76.
27.	0.35	1413.36	2012.	110.	6050818.	111.	1227.	67.	3568379.	66.
28.	0.47	6136.04	4762.	96.	22566722.	96.	3869.	78.	18242878.	77.
30.	3.69	4838.98	11218.	111.	21155828.	114.	6760.	67.	11907931.	64.
32.	2.04	1483.47	10742.	102.	5800484.	102.	8485.	80.	4581942.	80.
33.	0.29	441.64	2009.	112.	1908264.	112.	1372.	77.	1303457.	77.
35.	0.58	635.67	2080.	104.	2537160.	104.	1553.	77.	1894123.	77.
36.	0.06	101.09	234.	130.	505440.	130.	144.	80.	311040.	80.
38.	0.00	6.95	22.	136.	36353.	136.	13.	77.	20582.	77.
40.	72.22	32428.16	291495.	109.	136588912.	110.	217878.	82.	102173556.	82.
41.	3.68	1653.19	21637.	113.	7225955.	114.	14580.	76.	4878631.	77.
42.	32.88	18565.66	274582.	109.	77515769.	109.	196732.	78.	56884056.	80.
43.	24.44	13798.36	334986.	112.	59331097.	112.	225208.	75.	40057415.	75.
44.	3.03	2831.52	14805.	110.	11992102.	110.	9834.	73.	7965371.	73.
45.	1.40	1306.90	6975.	112.	5649371.	112.	4927.	79.	3990775.	79.
50.	58.90	28507.07	847874.	113.	122894575.	112.	560187.	74.	82447239.	75.
51.	1.51	972.17	20732.	113.	4188110.	112.	14452.	79.	2838798.	76.
52.	1.71	552.22	30074.	113.	2405902.	113.	20415.	77.	1633170.	77.
53.	0.30	96.14	5190.	112.	415207.	112.	3487.	75.	278961.	75.
54.	0.34	408.80	5839.	111.	1751765.	111.	4016.	77.	1204683.	77.
55.	1.38	5020.70	5568.	117.	22552194.	117.	3656.	77.	14806734.	77.
56.	1.86	6746.32	18099.	112.	28280693.	109.	12165.	75.	19784383.	76.
57.	4.58	2216.32	32144.	113.	9643235.	113.	21261.	75.	6378337.	75.
58.	2.54	1591.77	7243.	109.	6670256.	109.	5364.	80.	4797270.	78.
60.	0.04	24.71	458.	104.	98885.	104.	288.	65.	62165.	65.
61.	0.11	250.12	2012.	113.	1086326.	113.	1683.	94.	909076.	94.
62.	2.09	2021.76	2952.	123.	9564477.	123.	1296.	54.	4199038.	54.
63.	0.09	1239.38	2598.	111.	5306713.	111.	1595.	68.	3225945.	68.
TOTALS	248.68	177439.11	2107285.	112.	760113798.	111.	1441945.	76.	517549808.	76.

EXHIBIT 2-30

DES MOINES #2 SITE
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION, FOR ALL DAYS
COMPUTER PROGRAM F

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	ANNUAL SEASONALLY ADJUSTED TONS	SOUTH CENTROIDS				WEST CENTROIDS			
			CY SUM	CY COORD	LB SUM	LB COORD	CY SUM	CY COORD	LB SUM	LB COORD
1.	7.81	18903.64	33678.	111.	80827898.	111.	22857.	75.	54857148.	75.
2.	30.72	21240.64	151965.	112.	91178831.	112.	101502.	75.	60901344.	75.
3.	8.16	19996.27	35696.	113.	86740683.	113.	22432.	71.	54509301.	71.
4.	0.01	28.43	51.	113.	124003.	113.	29.	64.	70057.	64.
5.	2.28	6738.40	11401.	113.	29185833.	113.	7503.	74.	19207374.	74.
6.	3.70	6905.95	18129.	111.	29369081.	111.	12199.	74.	19761628.	74.
7.	0.09	193.60	335.	104.	771190.	104.	221.	68.	507512.	68.
10.	33.84	36850.91	227230.	108.	153380254.	108.	168283.	80.	113591017.	80.
11.	16.73	18218.97	111857.	108.	75503633.	108.	83732.	81.	56518970.	81.
12.	2.07	1337.91	17227.	107.	5512756.	107.	12042.	75.	3853358.	75.
13.	37.37	27127.99	421520.	109.	113810453.	109.	312516.	81.	84379374.	81.
14.	0.51	221.42	16556.	108.	915611.	108.	12111.	77.	653968.	77.
15.	0.34	184.73	5685.	108.	767419.	108.	3646.	69.	492205.	69.
20.	0.08	143.94	365.	114.	631104.	114.	227.	71.	393056.	71.
21.	0.03	44.64	174.	111.	189905.	111.	121.	77.	132026.	77.
22.	0.05	94.46	241.	115.	417795.	115.	134.	64.	232512.	64.
25.	0.65	1050.09	10296.	102.	4118563.	102.	7704.	76.	3081647.	76.
26.	1.54	2491.74	25642.	107.	10256798.	107.	17945.	75.	7177959.	75.
28.	0.00	60.65	177.	123.	286934.	123.	78.	54.	125971.	54.
32.	0.00	1.40	11.	113.	6102.	113.	8.	76.	4104.	76.
33.	0.02	27.66	119.	106.	113088.	106.	85.	76.	81016.	76.
40.	0.14	61.67	730.	104.	251701.	106.	610.	87.	210125.	89.
42.	0.30	167.57	5116.	111.	716285.	111.	3404.	74.	476626.	74.
43.	4.75	2681.80	80670.	109.	11293802.	109.	53440.	73.	7481579.	73.
44.	2.07	1933.73	9742.	106.	7890875.	106.	6176.	67.	5002372.	67.
45.	0.14	131.62	694.	111.	562059.	111.	411.	66.	333274.	66.
50.	0.88	427.67	15085.	110.	1810168.	110.	10952.	80.	1314184.	80.
51.	0.33	212.01	5342.	105.	854758.	105.	3390.	67.	542474.	67.
52.	1.12	361.71	18885.	109.	1510805.	109.	12353.	71.	988209.	71.
53.	0.17	55.17	2867.	108.	229371.	108.	1947.	73.	155794.	73.
54.	0.71	853.40	12301.	112.	3690281.	112.	7970.	73.	2391124.	73.
55.	1.20	4366.26	4454.	107.	18039949.	107.	2753.	66.	11148269.	66.
56.	1.08	3922.60	12154.	109.	16407361.	109.	8262.	74.	11153089.	74.
57.	5.49	2656.87	34890.	102.	10467034.	102.	25887.	76.	7766247.	76.
58.	0.40	247.88	1677.	123.	1173697.	123.	1135.	83.	794430.	83.
59.	0.93	1129.44	4035.	111.	4841998.	111.	2751.	76.	3300959.	76.
60.	0.01	4.94	85.	97.	18438.	97.	66.	75.	14256.	75.
61.	0.09	198.24	1513.	107.	816987.	107.	954.	68.	515138.	68.
TOTALS	165.83	181276.03	1298996.	109.	764683502.	110.	927835.	78.	534119695.	77.

EXHIBIT 2-31

ALL SITES
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION FOR ALL DAYS
COMPUTER PROGRAM F

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MATL       ANNUAL
CLASS      SEASONALLY                   SOUTH CENTROIDS                   -              WEST CENTROIDS
           ADJUSTED
         COMPACTED   TONS          CY SUM  CY COORD    LB SUM   LB COORD        CY SUM  CY COORD    LB SUM  LB COORD
           AC. FT.
   1.      11.21  27133.88          48052.      111.115384941.     111.          34016.       78. 81680328.      78.
   2.      47.84  33079.73         234495.      111.141088444.     111.         165608.       78. 99652787.      78.
   3.      17.44  42725.33          74327.      112.184488759.     112.          54310.       82.134395687.      82.
   4.       0.18    603.31            958.      100.  2328731.     100.            793.       83.  1927876.      83.
   5.       4.26  12576.64          20320.      108. 52020315.     108.          14812.       78. 37918358.      78.
   6.      12.19  22752.37          58118.      108. 94728253.     108.          44328.       83. 72219953.      83.
   7.       1.68   3457.84           6668.      115. 15337402.     115.           4928.       85. 11333357.      85.
  10.      43.53  47401.41         284606.      105.192108809.     105.         216531.       80.146158509.      80.
  11.      21.98  23932.18         143744.      105. 97027262.     105.         112851.       83. 76174750.      83.
  12.       2.51   1620.85          20307.      104.  6498171.     104.          14607.       75.  4674355.      75.
  13.      51.24  37202.76         573722.      108.154904899.     108.         439258.       83.118599535.      83.
  14.       1.10    477.68          34365.      103.  1896932.     103.          26742.       80.  1485256.      81.
  15.       2.17   1180.85          35897.      107.  4849394.     107.          29177.       87.  3941212.      87.
  20.       3.51   6116.83           6938.      120. 28464389.     121.           3401.       59. 13285184.      56.
  21.       4.22   6190.52          19712.      153. 33552886.     141.           9256.       72. 15386039.      65.
  22.       0.55    953.58           2426.      114.  4196978.     114.           1459.       69.  2524761.      69.
  25.       0.85   1364.27          12931.      104.  5461674.     104.           9359.       75.  3912739.      75.
  26.       2.94   4748.74          44664.      107. 19491889.     107.          32476.       77. 14168245.      78.
  27.       0.35   1413.36           2012.      110.  6050818.     111.           1227.       67.  3568379.      66.
  28.       0.47   6196.69           4939.       97. 22853656.      96.           3947.       77. 18368849.      77.
  30.       3.70   4845.90          11241.      111. 21185449.     114.           6781.       67. 11935400.      64.
  32.       2.05   1484.87          10753.      102.  5806586.     102.           8493.       80.  4586046.      80.
  33.       0.31    469.30           2128.      112.  2021352.     112.           1457.       77.  1384473.      77.
  35.       2.20   2403.04           7837.      103.  9560797.     103.           6473.       85.  7896535.      85.
  36.       0.10    179.71            389.      121.   839808.     122.            266.       83.   575640.      83.
  38.       0.00      6.95             22.      136.    36353.     136.             13.       77.    20582.      77.
  40.      82.48  37038.49         345227.      105.152049418.     107.         272155.       83.117817062.      83.
  41.       4.50   2022.15          27086.      113.  8812708.     113.          19255.       80.  6205311.      80.
  42.      34.51  19487.54         298863.      109. 81252573.     108.         217343.       79. 60110185.      80.
  43.      37.37  21102.25         535992.      110. 88992954.     110.         385960.       79. 63997759.      79.
  44.       6.50   6063.70          30980.      107. 25012856.     107.          21439.       74. 17365973.      74.
  45.       1.94   1814.44           9168.      106.  7426429.     106.           6762.       78.  5477529.      78.
  50.      69.23  33509.14        1000659.      110.142229217.     110.         701146.       77.100256756.      78.
  51.       2.80   1804.07          40913.      107.  7417182.     107.          31269.       82.  5529515.      80.
  52.       4.13   1333.11          69382.      108.  5550600.     108.          50710.       79.  4056798.      79.
  53.       0.77    247.28          13007.      109.  1040524.     109.           9657.       81.   772587.      81.
  54.       1.81   2188.60          30361.      108.  9108351.     108.          22229.       79.  6668638.      79.
  55.       3.40  12324.83          12257.      105. 49639111.     105.           8715.       74. 35297337.      74.
  56.       4.80  17438.66          49121.      105. 70161364.     105.          36458.       78. 52579463.      78.
  57.      11.69   5658.73          75738.      104. 22721352.     104.          55697.       77. 16709071.      77.
  58.       3.24   2030.12           9945.      110.  8561945.     110.           7418.       82.  6235601.      80.
  59.       0.93   1129.44           4035.      111.  4841998.     111.           2751.       76.  3300959.      76.
  60.       0.15     89.86           1528.       95.   330005.      95.           1156.       72.   249618.      72.
  61.       0.47   1020.29           7070.       97.  3817602.      97.           5808.       80.  3136268.      80.
  62.       2.22   2149.38           3489.      122. 10144145.     123.           1722.       60.  4659540.      56.
  63.       0.11   1378.38           2809.      105.  5648857.     107.           1859.       70.  3653625.      69.
  70.       0.10    152.42            322.       96.   562800.      96.            275.       82.   480725.      82.
  73.       0.15    213.82            589.      115.   942176.     115.            520.      101.   832576.     101.


TOTALS    511.87 460715.30        4230011.      109.**********     109.        3102875.       80.**********      79.
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EXHIBIT 2-32

SOUTHWEST AREA
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION SORTED BY A TIME LINE INTO TWO SANITARY LANDFILL ZONES,
COMPUTER PROGRAM G

```
 MATL       ANNUAL
 CLASS    SEASONALLY                         SOUTH CENTROIDS                                        WEST CENTROIDS
           ADJUSTED
-----------------------------------------------------------------------------------------------------------------------------
        COMPACTED   TONS           CY SUM  CY COORD   LB SUM   LB COORD        CY SUM  CY COORD   LB SUM   LB COORD
          AC. FT.
    1.     2.66    6425.45         11808.      115. 28339082.      115.          9306.       90. 22334075.       90.
    2.    14.14    9777.69         71299.      114. 42779319.      114.         56935.       91. 34161041.       91.
    3.     7.82   19160.78         34290.      115. 85191507.      116.         28282.       95. 69935133.       95.
    4.     0.09     304.59           538.      112.  1308452.      112.           456.       94.  1107023.       94.
-----------------------------------------------------------------------------------------------------------------------------
    5.     1.08    3182.90          5609.      117. 14359444.      117.          4286.       90. 10971360.       90.
    6.     4.36    8138.84         22321.      116. 36160331.      116.         18609.       96. 30146900.       96.
    7.     0.75    1536.47          3088.      120.  7102738.      120.          2450.       95.  5634282.       95.
   10.    21.97   23921.76        152752.      112.103107645.      112.        124456.       91. 84007716.       91.
   11.    11.49   12512.16         80398.      113. 54268335.      113.         65879.       92. 44468431.       92.
   12.     1.16     746.20         10075.      112.  3224135.      112.          7960.       89.  2547316.       89.
-----------------------------------------------------------------------------------------------------------------------------
   13.    28.50   20687.79        333366.      113. 90008722.      113.        270472.       92. 73027555.       92.
   14.     0.42     184.43         14012.      113.   797885.      112.         11222.       90.   647202.       91.
   15.     1.09     594.92         19122.      113.  2581487.      113.         16349.       96.  2207167.       96.
   20.     0.02      40.48           101.      113.   175422.      113.            83.       92.   143417.       92.
   21.     0.89    1310.37          5579.      121.  6081217.      121.          4221.       91.  4600929.       91.
   25.     0.08     123.60          1293.      109.   517242.      109.          1258.      106.   503122.      106.
-----------------------------------------------------------------------------------------------------------------------------
   26.     0.36     583.86          6477.      115.  2590743.      115.          5138.       92.  2055001.       92.
   27.     0.02      63.96           185.      113.   277920.      113.           139.       84.   207780.       84.
   28.     0.01      70.76           178.      106.   288489.      106.           173.      103.   280325.      103.
   30.     0.23     307.75          1100.      121.  1429590.      121.           831.       91.  1080339.       91.
   32.     0.01       7.02            62.      124.    33480.      124.            39.       79.    21330.       79.
   33.     0.04      55.33           268.      120.   254353.      120.           192.       86.   182609.       86.
-----------------------------------------------------------------------------------------------------------------------------
   35.     0.92    1009.33          3593.      113.  4383239.      113.          3200.      101.  3903755.      101.
   36.     0.10     179.71           389.      121.   839808.      122.           266.       83.   575640.       83.
   38.     0.00       6.95            22.      136.    36353.      136.            13.       77.    20582.       77.
   40.    41.46   18617.81        186375.      116. 82676884.      115.        147311.       91. 64470906.       90.
   41.     1.55     694.67         11397.      121.  3219822.      121.          8388.       89.  2374150.       89.
   42.    11.59    6547.08        113751.      117. 29037274.      115.         85947.       88. 22394482.       89.
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   43.    13.31    7518.03        197779.      115. 33211303.      115.        155733.       90. 26070760.       90.
   44.     1.83    1710.81          9297.      114.  7530247.      114.          7072.       87.  5728407.       87.
   45.     0.69     643.40          3659.      120.  2964076.      120.          2638.       86.  2136770.       86.
   50.    16.63    8050.83        248529.      115. 35661158.      115.        200539.       93. 28724535.       93.
   51.     1.02     660.75         18279.      115.  2924586.      115.         15007.       94.  2401189.       94.
   52.     1.35     434.63         23885.      114.  1910817.      114.         18590.       89.  1487229.       89.
-----------------------------------------------------------------------------------------------------------------------------
   53.     0.27      86.95          4919.      118.   393488.      118.          3875.       93.   310009.       93.
   54.     0.79     957.08         13943.      114.  4182927.      114.         10615.       87.  3184430.       87.
   55.     0.76    2753.07          3160.      121. 12798623.      121.          2186.       84.  8854492.       84.
   56.     1.39    5028.60         16972.      118. 22912759.      118.         12920.       90. 17441690.       90.
   57.     1.69     819.43         12618.      120.  3785265.      120.          9175.       87.  2752604.       87.
   58.     0.94     591.04          3823.      118.  2676320.      118.          2982.       92.  2087112.       92.
-----------------------------------------------------------------------------------------------------------------------------
   61.     0.13     290.35          2293.      111.  1238052.      111.          2026.       98.  1093851.       98.
   62.     0.13     127.62           537.      118.   579668.      118.           426.       94.   460501.       94.
   73.     0.15     208.00           575.      115.   920000.      115.           510.      102.   816000.      102.


 TOTALS  193.90  166673.25       1649717.      115.734760208.      115.       1318156.       91.587559195.      92.
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EXHIBIT 2-33

NORTHEAST AREA
CENTROIDS OF REFUSE BY MATERIAL CLASSIFICATION SORTED BY A TIME LINE INTO TWO SANITARY LANDFILL ZONES
COMPUTER PROGRAM G

MATL CLASS	ANNUAL SEASONALLY ADJUSTED COMPACTED AC. FT.	TONS	SOUTH CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD	WEST CENTROIDS CY SUM	CY COORD	LB SUM	LB COORD
1.	8.56	20708.43	36244.	109.	87045859.	109.	24710.	75.	59346252.	75.
2.	33.69	23297.36	163143.	110.	98277625.	110.	108634.	73.	65468345.	73.
3.	9.62	23564.55	40036.	110.	99297251.	110.	26028.	71.	64460504.	71.
4.	0.09	298.71	420.	89.	1020279.	89.	338.	71.	820854.	71.
5.	3.18	9393.74	14711.	104.	37660871.	104.	10526.	75.	26946998.	75.
6.	7.83	14613.53	35797.	104.	58567922.	104.	25719.	75.	42073054.	75.
7.	0.93	1921.37	3580.	111.	8234664.	111.	2478.	77.	5699076.	77.
10.	21.56	23479.65	131854.	99.	89001163.	99.	92075.	69.	62150794.	69.
11.	10.49	11420.02	63347.	97.	42758927.	97.	46972.	72.	31705319.	72.
12.	1.36	874.65	10231.	97.	3274037.	97.	6647.	63.	2127039.	63.
13.	22.75	16514.97	240356.	102.	64896177.	102.	168785.	72.	45571980.	72.
14.	0.67	293.25	20353.	97.	1099046.	97.	15520.	74.	838054.	74.
15.	1.08	585.66	16760.	101.	2265903.	101.	12822.	77.	1733276.	77.
20.	3.48	6076.35	6837.	120.	28288967.	121.	3318.	58.	13141767.	56.
21.	3.23	4727.11	8739.	114.	21591557.	119.	4603.	60.	10314230.	57.
22.	0.55	953.58	2426.	114.	4196978.	114.	1459.	69.	2524761.	69.
25.	0.77	1240.67	11638.	103.	4944432.	104.	8102.	72.	3409617.	71.
26.	2.58	4164.89	38187.	105.	16901146.	106.	27339.	75.	12113244.	75.
27.	0.33	1349.40	1827.	110.	5772898.	111.	1088.	66.	3360599.	65.
28.	0.47	6125.93	4761.	96.	22565166.	96.	3774.	76.	18088525.	77.
30.	3.46	4538.16	10141.	110.	19755859.	113.	5950.	64.	10855051.	62.
32.	2.04	1477.85	10691.	102.	5773106.	102.	8453.	80.	4564716.	80.
33.	0.27	413.97	1860.	111.	1766999.	111.	1265.	75.	1201864.	75.
35.	1.27	1393.71	4244.	97.	5177559.	97.	3273.	74.	3992780.	74.
40.	41.02	18420.68	158852.	95.	69372534.	98.	124844.	75.	53346156.	75.
41.	2.96	1327.48	15688.	108.	5592886.	110.	10867.	75.	3831161.	75.
42.	22.92	12940.46	185112.	105.	52215299.	105.	131396.	74.	37715703.	76.
43.	24.05	13581.93	338058.	107.	55759821.	107.	230163.	73.	37918034.	73.
44.	4.66	4352.89	21583.	104.	17482608.	104.	14367.	70.	11637566.	70.
45.	1.25	1171.04	5509.	99.	4462353.	99.	4124.	74.	3340759.	74.
50.	52.60	25458.31	752130.	109.	106568058.	109.	500607.	73.	71532221.	73.
51.	1.77	1140.30	22502.	100.	4471357.	102.	16199.	72.	3118165.	71.
52.	2.78	898.49	45497.	105.	3639783.	105.	32120.	74.	2569569.	74.
53.	0.50	160.01	8047.	105.	643735.	105.	5765.	75.	461198.	75.
54.	1.02	1231.52	16418.	104.	4925424.	104.	11614.	74.	3484208.	74.
55.	2.64	9571.77	9096.	100.	36840488.	100.	6529.	72.	26442846.	72.
56.	3.42	12410.06	32149.	99.	47248605.	99.	23538.	73.	35137773.	74.
57.	10.00	4839.31	63120.	102.	18936087.	102.	46522.	75.	13955467.	75.
58.	2.28	1428.15	6014.	104.	5810026.	106.	4383.	76.	4110689.	75.
59.	0.93	1129.44	4035.	111.	4841998.	111.	2751.	76.	3300959.	76.
60.	0.15	89.86	1528.	95.	330005.	95.	1156.	72.	249618.	72.
61.	0.34	729.94	4777.	92.	2579549.	92.	3782.	73.	2042417.	73.
62.	2.09	2021.76	2952.	123.	9564477.	123.	1296.	54.	4199038.	54.
63.	0.11	1378.38	2809.	105.	5648857.	107.	1859.	70.	3653625.	69.
70.	0.10	152.42	322.	96.	562800.	96.	275.	82.	430725.	82.
73.	0.00	5.82	14.	99.	22176.	99.	10.	74.	16576.	74.
TOTALS	317.84	293867.53	2574394.	105.	**********	105.	1784044.	73.	815055229.	72.

EXHIBIT 2-34

Exhibit 2-35

Identification of Political Sub-Divisions For Solid Waste Study Area

Sub-Division No.	
1.	Des Moines
2.	West Des Moines
3.	Altoona
4.	Ankeny
5.	Bondurant
6.	Clive
7.	Grimes
8.	Pleasant Hill
9.	Urbandale
10.	Windsor Heights
11.	Carlisle
12.	Norwalk
13.	Polk County
14.	Warren County
15.	Avon
16.	Berwick
17.	(Not Used)
18.	Cumming
19.	Elkhart
20.	Johnson
21.	Mitchellville
22.	Norwoodville
23.	Polk City
24.	Runnells
25.	Saylorville
26.	Sheldahl
27.	Dallas County
28.	Madison County
29.	(Not Used)
30.	Story County
31.	(Not Used)
32.	Boone County
33.	Marquisville

EXHIBIT 2-35

METROPOLITAN DES MOINES SOLID WASTE STUDY

INDUSTRIAL SOLID WASTE SURVEY
QUESTIONNAIRE

Name of Establishment: ______________________________________

____.

Type of Business: ____

____.

Principal Address in Des Moines Metropolitan Area: ______________

____

____.

Name of Person to Contact in Event Additional Information is Required:

______________________ Position: ______________________

Address ____

Phone Number ____.

1. Is it necessary that the information in this questionnaire be considered confidential? Yes ( ) No ( ). (If any information is given to us which is to be kept confidential, we will use the information in such a way as to prevent the identification of the waste source in reports issued, and make the data known only to responsible officials who would require specific knowledge in the review and evaluation of the report.)

2. Location of Principal Source of Waste (Address): ______________

   ____

   ____.

EXHIBIT 2-36

3. Brief General Description of the Type or Types of Solid Waste:

4. Approximate Quantity of Solid Waste per Average Week or Month. (Please give rough estimate in pounds or tons or some measure of the volume, and state if per week or per month or any other convenient unit of time.)

5. Current Method of Disposal of this Solid Waste:

6. Is there anything about this waste that you know, which would classify this waste as hazardous, such as highly inflammable, explosive, corrosive, biologically contaminated, etc? Yes ( ) No ( )

7. If you are uncertain about anything we have requested, or wish assistance, or would like to impart specific information which is difficult to fit into this form, please check this space and we will contact you. ( ).

EXHIBIT 2-36a

METROPOLITAN DES MOINES SOLID WASTE ENGINEERING STUDY

INDUSTRIAL AND COMMERCIAL SOLID WASTE SURVEY

1. Name of Establishment ______________________________

____

2. Address where waste is Generated ______________________________

____

3. Person to Contact for Information: Name ______________________________

______________ Title ______________________________

Adress ______________________________

Phone ______________________________

4. General Description of Waste ______________________________

____

____

5. Present Quantity of Waste ______________________________

____

6. Seasonal Variation ______________________________

____

7. Future Quantities ______________________________

____

8. Current Method of Collection and Disposal ______________________________

____

9. **Detailed Description of Waste** ______________________________

a. **Weight, gross** ______________________________

b. **Weight, unit** ______________________________

EXHIBIT 2-37

c. Volume reduction in land fill____________________

d. Volume reduction in press____________________

e. Moisture content____________________

f. Moisture retention____________________

g. % combustible________________ % Ash__________

h. % Non-combustible____________________

i. % Metallic________________ % Magnetic __________

j. Potential for being wind blown____________________

k. Explosive____________________

l. Highly flammable____________________

m. Toxic____________________

n. Other hazard____________________

o. Soluble in water____________________

p. Potential pollution if in contact with water____________________

q. Odor problem ____________________

r. Smoke or gas problem if burned____________________

s. Biological degradible or digestible____________________

t. Organic vs. inorganic____________________

u. Chemical Composition____________________

v. Salvage____________________

EXHIBIT 2-37a

SOLID WASTE COLLECTION • DRIVERS DAILY REPORT - DATE: ____________________

DISTRICT ________ ROUTE ________ VEHICLE NO. ________ OPEN-PACKER, CAPACITY ________ C.Y. ________ MAN CREW ______

LOAD NO.		COLLECTION				HAUL				DELAY				REMARKS
		CLOCK	MIN	METER	MILES	CLOCK	MIN	METER	MILES	CLOCK	MIN	METER	MILES	
TOTAL														

DRIVER ________________________

HELPER ________________________

HELPER ________________________

	TIME	MILES
COLLECTION		
HAUL		
DELAY		
TOTAL		

LOAD	CY	TONS
1		
2		
3		
4		
TOTAL		

BLOCKS COLLECTED: FROM __________ TO __________

REMARKS ____

EXHIBIT 3-1

REFUSE COLLECTION

FOREMAN'S DAILY RECAP WORK SHEET - MONTH OF ______ 19____ DIST. _____ ROUTE _____ DAY _____

DATE	CREW NO.	NO. COLLS.	LOADS	C.Y.	TONS			COLL. TIME	HAUL TIME	DELAY TIME	TOTAL TIME	COLL. MILES	HAUL MILES	DELAY MILES	TOTAL MILES	COMP. HOURS	INCENT. HOURS
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
		▨						:	:	:	▨				▨	:	:
TOTAL	▨							:	:	:	:					:	:
AVG. PER COL.								:	:	:	:					:	:

REMARKS:

EXHIBIT 3-2

MONTHLY DISTRICT REFUSE COLLECTION SUMMARY

MONTH OF__________ 19___ DISTRICT____

ROUTE NO.	DAY	NO. COLLS	LOADS	C.Y.	TONS			COLL. TIME	HAUL TIME	DELAY TIME	TOTAL TIME	COLL. MILES	HAUL MILES	DELAY MILES	TOTAL MILES	COMP. HOURS	INCENT HOURS
ONE	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																
TWO	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																
THREE	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																
FOUR	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																

EXHIBIT 3-3

MONTHLY DISTRICT REFUSE COLLECTION SUMMARY MONTH OF________ 19___ DISTRICT____

ROUTE NO.	DAY	NO. COLLS	LOADS	C.Y.	TONS			COLL. TIME	HAUL TIME	DELAY TIME	TOTAL TIME	COLL. MILES	HAUL MILES	DELAY MILES	TOTAL MILES	COMP. HOURS	INCENT HOURS
FIVE	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																
SIX	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																
SEVEN	1																
	2																
	3																
	4																
	5																
SUB TOTAL	▨																
AVG. / COL.	▨																
TOTAL THIS MONTH																	
AVG. / COL. THIS MONTH																	
AVG. / COL LAST MONTH																	
AVG./COL. THIS MONTH LAST YEAR																	
AVG./COL. LAST 12 MONTHS																	

REMARKS

EXHIBIT 3-3a

MONTHLY REFUSE COLLECTION SUMMARY - ALL DISTRICTS MONTH OF__________ 19____

	DAY	NO. COLLS.	LOADS	C.Y.	TONS			COLL. TIME	HAUL TIME	DELAY TIME	TOTAL TIME	COLL. MILES	HAUL MILES	DELAY MILES	TOTAL MILES	COMP. HOURS	INCENT. HOURS
DISTRICT I																	
ROUTE 1																	
ROUTE 2																	
ROUTE 3																	
ROUTE 4																	
ROUTE 5																	
ROUTE 6																	
ROUTE 7																	
SUB TOTAL																	
AVG./COLL.																	
DISTRICT II																	
ROUTE 1																	
ROUTE 2																	
ROUTE 3																	
ROUTE 4																	
ROUTE 5																	
ROUTE 6																	
ROUTE 7																	
SUB TOTAL																	
AVG./COLL.																	
DISTRICT III																	
ROUTE 1																	
ROUTE 2																	
ROUTE 3																	
ROUTE 4																	
ROUTE 5																	
ROUTE 6																	
ROUTE 7																	
SUB TOTAL																	
AVG./COLL.																	
ALL DISTRICTS																	
TOTAL																	
AVG./COLL.																	

EXHIBIT 3-4

REFUSE COLLECTION REPORT FOR THE MONTH OF_______ 19___

ITEMS	TOTAL THIS MO.	AVERAGE PER ROUTE COLLECTED			
		THIS MO.	LAST MO.	THIS MO. LAST YR.	12 MO. AVG.
1. Routes Collected					
2. Loads to Land Fill					
3. Cubic Yards Collected					
4. Tons Collected					
5.					
6.					
7. Collection Time					
8. Haul Time					
9. Delay Time					
10. Total Time					
11. Collection Miles					
12. Haul Miles					
13. Delay Miles					
14. Total Miles					
15. Compensatory Crew Hours					
16. Incentive Crew Hours					
17. Equipment Hours					
18. Regular Time Labor Cost					
19. Compensatory Labor Cost					
20. Total Labor Cost					
21. Equipment Cost					
22. Material Cost					
23. Total Cost					
24. Labor Cost Per C.Y. Collected					
25. Equip. Cost Per C.Y. Collected					
26. Total Cost Per C.Y. Collected					

TOTAL DEPT. DIRECT PRODUCTION WAGES THIS MONTH __________ $__________

TOTAL DEPT. DIRECT SUPERVISION WAGES THIS MONTH __________ $__________

TOTAL DEPT. ADMINISTRATION WAGES THIS MONTH __________ $__________

SUBTOTAL __________ $__________

ACCRUAL FOR VACATION, SICK LEAVE, HOLIDAYS _____ % ______ $__________

OVERHEAD FOR PAYROLL EXPENSES _____ % ______ $__________

TOTAL LABOR COST THIS MONTH __________ $__________

MAN-HOURS OF DIRECT PRODUCTION THIS MONTH _______ MAN-HOURS

HOURLY RATE FOR DIRECT PRODUCTION LABOR $______ ÷ ______ MH = $______ PER HR.

REMARKS:

EXHIBIT 3-5

SAMPLE PAGE
COLLECTION
SURVEY REPORT

ROUTE BOOK and BASIC COLLECTION DATA ROUTE NO. 7 DATE 8-15-67 DAY Tuesday 1 OF 1

BLOCK	ON	HEAD	FROM	TO	SIDES	TURN	STOPS	CONT.	START	FINISH	REMARKS
	44	No.	Sheridan	Urbandale	B	R	6	21	7:25	7:35	22 D.U.
	Urbandale	E.	44	41	R	R	4	16	7:35	7:39	15 D.U.
	41	So.	Urbandale	Sheridan	B	R	3	25	7:39	7:46	14 D.U.
	— Dead Head W. on Sheridan to 42										
	42	No.	Sheridan	New York	B	L	2	16	7:47	7:53	11 D.U.
	New York	W.	42	43	B	R	2	7	7:53	7:55	7 D.U.
	43	No.	New York	Urbandale	B	T.A.	3	17	7:55	8:00	9 D.U.
	— Dead Head So. on 49 to New York										
	New York	W	49	48	B	R	6	28	8:01	8:10	23 D.U.
	— Dead Head No. on 48 to Snyder										
	Snyder	W	48	49	B	R	3	23	8:11	8:16	12 D.U.
	— Dead Head No. on 49 to Urbandale, E on Urbandale to 45										
	45	So.	Urbandale	Hickman	B	R.	9	107	8:18	8:48	76 D.U.
	Hickman	W	45	47	R	-	2	10	8:48	8:54	10 D.U.
	— To Coffee at Chile King (Hickman & Merle Hey)										
	46	No.	Hickman	Urbandale	B	L	14	115	9:21	9:56	76 D.U.
	— Dead Head W on Urbandale to 47										
	47	So.	Urbandale	Hickman	B	R	14	104	10:05	10:38	80 D.U.
	Hickman	W.	47	48	R	R	1	2	10:44	10:46	9 D.U.
	48	No.	Hickman	Urbandale	B	-	18	116	10:46	11:20	84 D.U.
	— To Pick Up Missed House then to Lunch at Park (34th & Adams) See Notes										
	48 PL.	No	Hickman	Urbandale	B	R	14	101	12:35	13:08	81 D.U.
	— Dead Head E. on Urbandale to 44, So. on 44 to Beaver Crest Drive										
	Beaver Crest	W	44	48	B	R	5	33	13:21	13:37	26 D.U.
	— Dead Head So on 48 to Holcomb										
	Holcomb	E	48	46	B	-	3	12	13:43	13:48	D.U. Were Counted from Cross Streets
	— Dead Head E. on Holcomb to 45										
	Holcomb	E	45	44	B	-	3	5	13:48	13:50	D.U. Were Counted from Cross Streets
	— End of Usual Route, to Coffee at Bowling Alley at Douglas & Harding										

EXHIBIT 3-6

Exhibit 3-7

ROUTE DAYS COLLECTED WHILE BEING OBSERVED

Rt. No.	Date 1967	Day	Comment	% of One Day
1	8/28	M	All of Mon. and part of Tues.	125
1	9/1	F	All of Fri. and parts of Mon. and another route	180
2	6/22	Th	All of Thurs. and part of Mon.	126
3	8/23	W	All of Wed. and parts of Tues. and Thurs.	117
4	8/14	M	All of Mon. and parts of Tues.	108
5	6/26	M	All of Monday	100
7	8/15	T	All of Tuesday	100
8	8/22	T	All of Tues. and part of Fri.	115
9	8/30	W	Part of Wed. and parts of Tues. and Thurs.	134
10	8/16	W	Part of Wed. and parts of Thurs. and Fri.	181
11	8/24	Th	Most of Thursday	90
14	6/28	W	All of Thurs. and parts of Wed. and Fri.	197
15	8/23	W	Most of Wed. and part of Tues.	108
16	8/29	T	Most of Tues. and parts of Mon., Wed. and Thurs.	109
17	6/23	F	All of Wed. and parts of Tues. and Thurs.	160
18	8/24	Th	Most of Thurs and part of Wed.	100
19	6/22	Th	All of Thurs. and part of Fri.	112
19	9/1	F	Parts of Mon., Wed. and Fri.	132
20	8/25	F	All of Fri. and parts of Thurs. and Mon.	210
21	8/18	F	Most of Fri. and parts of Thurs. and Mon.	171
22	6/22	Th	Parts of Wed. and Thurs.	100
23	8/21	M	All of Monday	100
24	8/28	M	All of Wed. and part of Tues.	110
25	6/27	T	All of Tues. and part of Wed.	131
26	8/22	T	All of Tuesday	100
27	6/22	Th	Parts of Mon. and Tues.	100
			Average	127

EXHIBIT 3-7

SOLID WASTES STUDY - COLLECTION SURVEY

SHEET 1 OF 6

			WEIGHT (LBS)	MILES	STOPS	DWELLING UNITS	CON-TAINERS	TIME (MIN)	LBS PER CONT	PER MILE					PER STOP				PER DWELLING UNIT		
										STOPS	D U	CONT	MIN.	LBS.	D U	CONT	MIN	LBS.	CONT	SEC	LBS.
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ROUTE	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		1.19	11	36	26	28		9.2	30.2	21.8	23.5		3.3	2.4	2.5		.7	46.6	
		2- Sides		3.89	135	504	579	254		34.7	129.6	148.8	65.3		3.7	4.3	1.9		1.1	30.2	
1a	TOTALS		9,040	5.08	146	540	605	282	14.9	28.7	106.3	119.1	55.5	1775	3.7	4.1	1.9	48.9	1.1	31.3	16.7
ROUTE	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.41	14	21	28	18		34.1	51.2	68.3	43.9		1.5	2.0	1.3		1.3	51.4	
		2- Sides		3.79	125	501	417	229		33.0	134.8	124.0	60.4		4.0	3.3	1.8		.9	27.4	
1b	TOTALS		6,800	4.20	139	522	445	247	11.5	33.1	124.3	141.0	58.8	1622	3.8	4.3	1.8	48.9	1.1	28.4	13.0
ROUTE	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.58	13	37	30	22		22.4	63.8	51.7	37.9		2.3	2.3	1.7		.8	35.7	
		2- Sides		4.12	129	533	607	245		31.3	129.4	147.3	59.5		4.1	4.7	1.9		1.1	27.6	
2	TOTALS		6,400	4.70	142	570	637	267	10.0	24.9	121.3	135.5	56.8	1355	4.0	4.5	1.9	45.1	1.1	28.1	11.2
ROUTE	ALLEY	1- Side																			
		2- Sides		.09	6	23	25	10		66.7	255.6	277.8	111.1		3.8	4.2	1.7		1.1	26.1	
	STREET	1- Side		3.36	85	344	398	190		25.3	102.4	118.5	56.5		4.0	4.7	2.2		1.2	33.1	
		2- Sides		2.22	41	256	236	115		18.5	115.3	106.3	51.8		6.2	5.8	2.8		.9	27.0	
3	TOTALS		8,590	5.67	132	623	659	315	13.0	23.3	109.9	116.2	31.5	1,515	4.7	5.0	2.4	65.1	1.1	30.3	13.8
ROUTE	ALLEY	1- Side		.12	3	5	7	3		25.0	41.7	58.3	25.0		1.7	2.3	1.0		1.4	36.0	
		2- Sides		.09	6	11	13	7		66.7	122.2	144.4	77.8		1.8	2.2	1.2		1.2	38.2	
	STREET	1- Side		1.02	17	49	82	33		16.7	48.0	80.4	32.4		2.9	4.8	1.9		1.7	40.4	
		2- Sides		4.12	96	295	449	236		23.3	71.6	109.0	59.7		3.1	4.7	2.6		1.5	50.0	
4	TOTALS		5,420	5.35	122	360	551	279	9.8	22.8	67.3	103.0	52.1	1013	3.0	4.5	2.3	56.5	1.5	46.5	15.1

EXHIBIT 3-8

SOLID WASTES STUDY - COLLECTION SURVEY

SHEET 2 OF 6

ROUTE			WEIGHT (LBS) (1)	MILES (2)	STOPS (3)	DWELLING UNITS (4)	CON-TAINERS (5)	TIME (MIN) (6)	LBS PER CONT (7)	PER MILE STOPS (8)	PER MILE D U (9)	PER MILE CONT (10)	PER MILE MIN (11)	PER MILE LBS (12)	PER STOP D U (13)	PER STOP CONT (14)	PER STOP MIN (15)	PER STOP LBS (16)	PER DWELLING UNIT CONT (17)	PER DWELLING UNIT SEC (18)	PER DWELLING UNIT LBS. (19)
5	ALLEY	1- Side																			
		2- Sides		.11	7	16	19	4		63.6	145.5	172.7	36.4		2.3	2.7	.6		1.2	15.0	
	STREET	1- Side		2.35	39	319	280	125		16.6	135.8	119.1	53.2		8.2	7.7	3.2		.9	23.5	
		2- Sides		2.14	52	418	463	155		13.6	195.3	216.4	72.4		8.0	8.9	3.0		1.1	22.2	
	TOTALS		8,820	4.60	98	753	762	284	19.2	21.3	163.7	165.7	61.7	1917	7.7	7.8	3.0	90.0	1.0	22.6	11.7
7	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.18	3	13	12	8		16.7	72.2	66.7	44.4		4.3	4.0	2.7		.9	36.9	
		2- Sides		3.93	109	536	746	236		27.7	136.4	189.8	60.0		4.9	6.8	2.2		1.4	26.4	
	TOTALS		8,280	4.11	112	549	758	244	10.9	27.3	133.6	184.4	59.4	2010	4.9	6.8	2.2	73.9	1.4	26.7	18.2
8	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.07	3	10	14	6		42.9	142.9	200.0	85.7		3.3	4.7	2.0		1.4	36.0	
		2- Sides		3.20	92	378	403	208		28.9	118.1	129.9	65.0		4.1	4.4	2.3		1.1	33.0	
	TOTALS		5,350	3.27	95	388	417	214	12.8	29.1	118.7	127.5	65.4	1632	4.1	4.4	2.3	56.3	1.1	33.1	21.3
9	ALLEY	1- Side		.17	14	15	19	10		82.4	88.2	111.8	58.8		1.1	1.4	.7		1.3	40.0	
		2- Sides		.73	72	117	130	42		98.6	160.3	178.1	57.5		1.6	1.8	.6		1.1	21.5	
	STREET	1- Side		1.41	28	64	66	44		19.9	45.4	46.8	31.2		2.3	2.4	1.6		1.0	41.3	
		2- Sides		4.02	98	279	295	160		24.4	69.4	73.4	39.8		2.8	3.0	1.6		1.1	34.4	
	TOTALS		7,980	6.33	212	475	510	256	15.6	33.5	75.0	80.6	40.4	1257	2.2	2.4	1.2	37.6	1.1	32.3	16.8
10	ALLEY	1- Side		.07	4	13	16	8		57.1	185.7	228.6	114.3		3.3	4.0	2.0		1.2	36.9	
		2- Sides		2.24	243	818	703	174		108.5	365.2	313.8	77.7		3.4	2.9	.7		.9	12.8	
	STREET	1- Side		.80	26	99	79	53		32.5	123.8	98.8	66.3		3.8	3.0	2.0		.8	32.1	
		2- Sides		.57	20	97	86	43		35.1	170.2	150.9	75.4		4.9	4.3	2.2		.9	26.6	
	TOTALS		10,170	3.68	293	1027	884	278	11.5	79.6	279.1	242.2	75.5	2785	3.5	3.0	.9	34.7	.9	16.2	9.9

EXHIBIT 3-8a

SOLID WASTES STUDY - COLLECTION SURVEY

SHEET 3 OF 6

			WEIGHT (LBS)	MILES	STOPS	DWELLING UNITS	CON-TAINERS	TIME (MIN)	LBS PER CONT	PER MILE					PER STOP				PER DWELLING UNIT		
										STOPS	D U	CONT	MIN.	LBS	D U	CONT	MIN	LBS	CONT	SEC	LBS.
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ROUTE 11	ALLEY	1- Side		.04	1	6	5	3		25.0	150.0	125.0	75.0		6.0	5.0	3.0		.8	30.0	
		2- Sides		.73	81	323	295	71		111.0	442.5	404.1	97.3		4.0	3.6	.9		.9	13.2	
	STREET	1- Side		.87	27	176	144	77		31.0	202.3	165.5	88.5		6.5	5.3	2.9		.8	26.3	
		2- Sides		.33	10	83	111	40		30.3	251.5	336.4	121.2		8.3	11.1	4.0		1.3	28.9	
	TOTALS		7,650	1.97	119	588	555	191	13.8	60.4	298.5	281.7	97.0	3387	4.9	4.7	1.6	64.3	.9	19.5	13.0
ROUTE 14	ALLEY	1- Side		.17	11	14	14	8		64.7	82.4	82.4	47.1		1.3	1.3	.7		1.0	34.3	
		2- Sides		2.23	289	308	390	128		129.6	138.1	174.9	57.4		1.1	1.3	.4		1.3	24.9	
	STREET	1- Side		.99	28	63	74	47		28.3	63.6	74.8	47.5		2.3	2.6	1.7		1.2	44.8	
		2- Sides		1.08	29	119	152	63		26.9	110.2	140.7	58.3		4.1	5.2	2.2		1.3	31.8	
	TOTALS		8180	4.47	357	504	630	246	13.0	79.9	112.8	125.0	55.0	1625	1.4	1.8	.7	22.9	1.3	.29.2	16.2
ROUTE 15	ALLEY	1- Side		.01	1	1	1	2		100.0	100.0	142.9	200.0		1.0	1.0	1.0		1.0	120.0	
		2- Sides		.19	21	27	45	11		110.5	142.1	236.8	57.9		1.3	2.1	.5		1.7	24.4	
	STREET	1- Side		2.26	56	124	167	80		24.8	54.9	73.9	35.4		2.2	3.0	1.4		1.3	38.7	
		2- Sides		3.66	88	292	387	171		24.0	79.8	105.7	46.7		3.3	4.4	1.9		1.3	35.1	
	TOTALS		8,740	6.12	166	444	600	264	14.6	27.1	72.5	98.0	43.1	1431	2.7	1.0	1.6	52.7	1.4	35.7	19.7
ROUTE 16	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.60	16	25	30	19		26.7	41.7	50.0	31.7		1.6	1.9	1.2		1.2	45.6	
		2- Sides		3.95	115	385	480	198		29.1	97.5	121.5	50.1		3.3	4.2	1.7		1.2	30.9	
	TOTALS		7,100	4.55	131	410	510	217	13.9	28.8	90.1	112.1	47.7	1558	3.1	3.9	1.7	54.2	1.3	31.8	17.3
ROUTE 17	ALLEY	1- Side		.17	5	16	12	3		29.4	94.1	70.6	17.6		3.2	2.4	.6		.8	11.2	
		2- Sides		2.96	258	604	554	184		87.2	204.1	187.2	62.2		2.3	2.1	.7		.9	18.3	
	STREET	1- Side		1.36	19	66	63	52		14.0	48.5	46.3	38.2		3.5	3.3	2.7		1.0	47.3	
		2- Sides		.91	24	112	77	40		26.4	123.1	84.6	43.9		4.7	3.2	1.7		.7	21.4	
	TOTALS		8,820	5.40	306	798	706	279	12.5	56.7	147.8	130.7	51.7	1634	2.6	2.3	.9	28.8	.9	21.0	11.1

EXHIBIT 3-8b

SOLID. WASTES STUDY - COLLECTION SURVEY

SHEET 4 OF 6

			WEIGHT (LBS)	MILES	STOPS	DWELLING UNITS	CON-TAINERS	TIME (MIN)	LBS PER CONT	PER MILE					PER STOP				PER DWELLING UNIT		
										STOPS	D U	CONT	MIN	LBS	D U	CONT	MIN	LBS	CONT	SEC	LBS.
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ROUTE 18	ALLEY	1- Side																			
		2- Sides		3.41	413	766	883	250		121.1	224.6	258.9	73.3		1.9	2.1	.6		1.2	19.6	
	STREET	1- Side		.13	3	5	12	10		23.1	38.5	92.3	76.9		1.7	4.0	3.3		2.4	120.0	
		2- Sides		.09	1	7	7	5		11.1	77.8	77.8	55.6		7.0	7.0	5.0		1.0	4.3	
	TOTALS		12,430	3.63	417	778	902	265	13.8	114.9	214.3	248.5	73.0	3,324	1.9	2.2	.6	29.8	1.2	20.4	16.0
ROUTE 19a	ALLEY	1- Side																			
		2- Sides		3.91	410	773	784	226		104.9	197.7	200.5	57.8		1.9	1.9	.6		1.0	17.5	
	STREET	1- Side		.29	12	23	29	16		41.4	79.3	100.0	54.5		1.9	2.4	1.3		1.3	41.7	
		2- Sides																			
	TOTALS		9,790	4.20	422	796	813	242	12.0	150.5	189.5	193.6	57.6	2,323	1.9	1.9	.6	23.2	1.0	18.2	11.1
ROUTE 19b	ALLEY	1- Side		.21	7	14	11	8		33.3	66.7	52.4	38.1		2.0	1.6	1.1		.8	34.3	
		2- Sides		3.80	435	724	724	226		114.5	190.6	190.5	59.5		1.7	1.7	.5		1.0	18.7	
	STREET	1- Side		.02	3	4	3	3		150.0	200.0	150.0	150.0		1.3	1.0	1.0		.8	45.0	
		2- Sides		.04	3	7	7	4		75.0	175.0	175.0	100.0		2.3	2.3	1.3		1.0	34.3	
	TOTALS		9,590	4.07	448	749	745	241	12.9	110.1	183.0	183.0	59.2	2,361	1.7	1.7	.5	21.4	1.0	19.3	12.8
ROUTE 20	ALLEY	1- Side		.06	2	3	2	1		33.3	50.0	33.3	16.7		1.5	1.0	.5		.7	20.0	
		2- Sides		3.24	393	600	668	178		121.3	185.2	206.2	54.9		1.5	1.7	1.2		1.1	17.8	
	STREET	1- Side		.36	20	18	41	16		55.6	50.0	113.9	44.4		.9	2.1	.8		2.3	53.3	
		2- Sides		.85	33	125	127	40		38.8	147.1	149.4	47.1		3.8	3.8	1.2		1.0	19.2	
	TOTALS		10,940	4.51	448	746	838	235	13.1	99.3	165.4	185.8	52.1	2,426	1.7	1.9	.5	24.4	1.1	18.9	14.7
ROUTE 21	ALLEY	1- Side																			
		2- Sides		2.53	263	409	545	118		104.0	161.7	215.4	46.6		1.6	2.1	2.3		1.3	17.3	
	STREET	1- Side		.74	9	45	50	22		12.2	60.8	67.6	29.7		5.0	5.6	2.4		1.1	29.3	
		2- Sides		1.91	58	359	301	102		30.4	187.9	157.6	53.4		6.2	5.2	1.8		.8	17.0	
	TOTALS		12,440	5.18	330	813	896	242	13.9	63.7	156.9	173.0	46.7	2,405	2.5	2.7	.7	37.7	1.1	17.6	15.3

EXHIBIT 3-8c

SOLID WASTES STUDY - COLLECTION SURVEY

SHEET 5 OF 6

ROUTE			WEIGHT (LBS)	MILES	STOPS	DWELLING UNITS	CON-TAINERS	TIME (MIN)	LBS PER CONT	PER MILE					PER STOP				PER DWELLING UNIT		
										STOPS	D U	CONT	MIN.	LBS.	D U	CONT	MIN	LBS.	CONT	SEC	LBS.
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
22	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		2.77	25	82	138	180		9.0	29.6	49.8	65.0		3.3	5.5	7.2		1.7	131.7	
		2- Sides		3.52	53	341	557	230		15.1	96.9	158.2	65.3		6.4	10.5	4.3		1.0	40.5	
	TOTALS		6,450	6.29	78	423	695	410	9.3	12.4	67.2	110.5	65.2	1,025	5.4	8.9	5.3	82.7	1.6	58.2	15.2
23	ALLEY	1- Side																			
		2- Sides		3.21	324	551	479	128		100.9	171.7	149.2	39.9		1.7	1.5	.4		.9	13.9	
	STREET	1- Side		.82	32	61	63	31		39.0	74.4	76.8	37.8		1.9	2.0	1.0		1.0	30.5	
		2- Sides		1.85	62	240	231	108		33.5	129.7	124.9	58.4		3.9	3.7	1.7		1.0	27.0	
	TOTALS		8,650	5.88	418	852	773	267	11.2	71.1	144.9	131.5	45.4	1,473	2.0	1.8	.6	20.7	.9	18.8	10.2
24	ALLEY	1- Side																			
		2- Sides		.09	9	12	16	7		100.0	133.3	177.8	77.8		1.3	1.8	.8		1.3	35.0	
	STREET	1- Side		.81	20	60	56	35		24.7	74.1	69.1	43.2		3.0	2.8	1.8		.9	35.0	
		2- Sides		3.83	152	566	628	252		39.7	147.8	163.9	65.8		3.7	4.1	1.7		1.1	26.7	
	TOTALS		9,260	4.73	181	638	700	294	13.2	38.3	134.9	148.0	62.2	1,954	3.5	3.9	1.6	51.2	1.1	27.6	14.5
25	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.13	5	12	12	8		38.5	92.3	92.3	61.5		2.4	2.4	1.6		1.0	40.0	
		2- Sides		4.69	151	598	741	289		32.2	127.5	158.0	61.6		4.0	4.9	1.9		1.2	29.0	
	TOTALS		9,890	4.82	156	610	753	297	13.1	32.4	126.6	156.2	61.6	2,046	3.9	4.8	1.9	63.4	1.2	29.2	16.2
26	ALLEY	1- Side																			
		2- Sides		.13	8	15	18	10		61.5	115.4	138.5	76.9		1.9	2.3	1.3		1.2	40.0	
	STREET	1- Side		2.06	31	67	86	40		15.0	32.5	41.7	19.4		2.2	2.8	1.3		1.3	35.8	
		2- Sides		7.29	191	525	539	270		26.2	72.0	73.9	37.0		2.7	2.8	1.4		1.0	30.9	
	TOTALS		8,975	9.48	230	607	643	320	14.0	24.3	64.0	67.8	33.8	947	2.6	2.8	1.4	39.0	1.1	31.6	14.8

EXHIBIT 3-8d

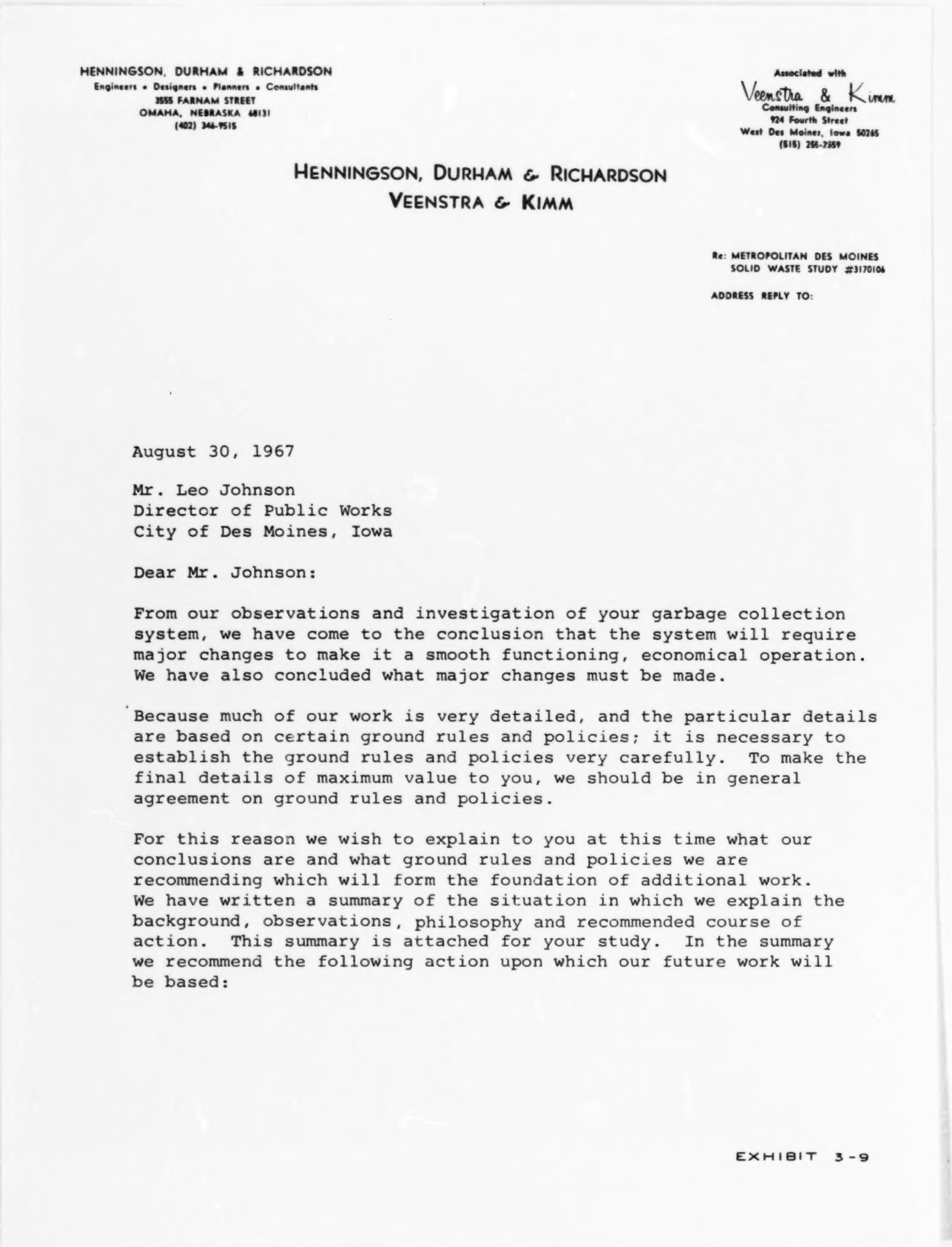
SOLID WASTES STUDY - COLLECTION SURVEY

SHEET 6 OF 6

			WEIGHT (LBS)	MILES	STOPS	DWELLING UNITS	CON- TAINERS	TIME (MIN)	LBS PER CONT	PER MILE					PER STOP				PER DWELLING UNIT		
										STOPS	D U	CONT	MIN	LBS	D U	CONT	MIN	LBS	CONT	SEC	LBS
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ROUTE	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side		.14	8	40	73	24		57.1	285.7	521.4	171.4		5.0	9.1	3.0		1.8	36.0	
		2- Sides		3.72	124	518	775	266		33.3	139.2	208.3	71.6		4.2	6.3	2.1		1.5	30.8	
27	TOTALS		8,060	3.86	132	558	848	290	9.5	34.2	144.6	219.7	75.1	2,087	4.2	6.4	2.2	61.1	1.5	31.2	14.4
ROUTE	ALLEY	1- Side																			
		2- Sides																			
	STREET	1- Side																			
		2- Sides																			
	TOTALS																				
ROUTE	ALLEY	1- Side		1.02	48	87	87	46		47.1	85.3	85.3	45.1		1.8	1.8	1.0		1.0	31.7	
		2- Sides		29.69	3238	6097	6291	1774		109.1	205.4	211.9	59.8		1.9	1.9	.5		1.1	17.5	
	STREET	1- Side		25.72	553	1863	2126	1187		21.5	72.4	82.7	46.2		3.4	3.8	2.1		1.1	38.2	
		2- Sides		69.72	2301	8186	8656	3969		33.0	117.4	124.2	56.8		3.6	3.8	1.7		1.1	29.0	
ALL	TOTALS		223,861	126.15	6140	16,233	17,160	6976	13.0	48.7	128.7	136.0	55.3	1775	2.6	2.8	1.1	36.5	1.1	25.8	13.8
ROUTE	ALLEY	1- Side %		.7	.8	.5	.5	.7													
		2- Sides %		23.5	52.7	37.6	36.7	25.4													
	STREET	1- Side %		20.4	9.0	11.5	12.4	17.0													
		2- Sides %		55.3	37.5	50.4	50.4	56.9													
ALL	TOTAL NO.		8,610	4.9	236	625	660	268	13.0												

PER DAY

EXHIBIT 3-8e



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HENNINGSON, DURHAM & RICHARDSON
VEENSTRA & KIMM

Re: METROPOLITAN DES MOINES
SOLID WASTE STUDY #3170106

ADDRESS REPLY TO:

August 30, 1967

Mr. Leo Johnson
Director of Public Works
City of Des Moines, Iowa

Dear Mr. Johnson:

From our observations and investigation of your garbage collection system, we have come to the conclusion that the system will require major changes to make it a smooth functioning, economical operation. We have also concluded what major changes must be made.

Because much of our work is very detailed, and the particular details are based on certain ground rules and policies; it is necessary to establish the ground rules and policies very carefully. To make the final details of maximum value to you, we should be in general agreement on ground rules and policies.

For this reason we wish to explain to you at this time what our conclusions are and what ground rules and policies we are recommending which will form the foundation of additional work. We have written a summary of the situation in which we explain the background, observations, philosophy and recommended course of action. This summary is attached for your study. In the summary we recommend the following action upon which our future work will be based:

EXHIBIT 3-9

1. The City routes be divided into several districts of managable size, each under the direction of a District Foreman. The Crews in a district are to act as a team.

2. Layout efficient routes which represent a proper days work.

3. Establish and enforce reasonable work rules which regulate the periods of collection, haul and rest.

4. Provide an incentive for the men to work fast and steadily without wasting time.

5. Provide the necessary management and supervision to properly direct the activities of the collection crews.

If there are any parts of these conclusions which are not acceptable to you please notify us immediately so we can meet to work out any modification to the basic ideas and have a sound foundation upon which to build.

Yours very truly,

HENNINGSON, DURHAM & RICHARDSON
VEENSTRA & KIMM

By R. J. Peterson
R. J. Peterson, P. E.
Project Engineer

RJP:m
1391
Encl.

EXHIBIT 3-90

SUMMARY OF THE COLLECTION SITUATION
(Attachment to Letter to Mr. Johnson August 30, 1967)

Under the present collection procedures the City is divided into approximately 28 Refuse Collection Routes most of which are divided into 5 parts, one for each of the five days of the week, Monday thru Friday, a few are shorter.

A refuse crew consisting of a truck driver and two collectors is assigned to each route. When on schedule, that is collecting Mondays work on Monday etc., the crew is expected to complete each day's work during the day if reasonably possible. Many of the present routes are not equal in size, are not equal to a day's work, nor are they efficiently laid out. As a result, it is extremely difficult to supervise and impossible to supervise well. The present policy is to assign some crews, on short routes finishing early, to assist longer routes or routes which have fallen behind for one reason or another. In many other cases crews finishing early proceed into their next day's work or simply waste time to fill up the day. When a crew has finished early and done part of the next day's work they can take a very leisurely pace the next day and punctuate the day with extended coffee breaks and an extra long lunch period. We cannot say that this is 100% typical because we have not observed all of the routes and also we have observed a few crews putting in a full or reasonably full day, but there is definitely a trend towards wasting time.

The crews should not be unduly criticized because the fault lies in the system. When the men are expected to spend a full day doing work which does not require a full day to complete, many crews will quite naturally accommodate the system by finding ways to waste time.

We recommend a five part solution to this problem.

1. The City routes be divided into several districts of manageable size, each under the direction of a District Foreman. The crews in a district are to act as a team.

2. Lay out efficient routes which represent a proper day's work.

3. Establish and enforce reasonable work rules which regulate the periods of collection, haul and rest.

EXHIBIT 3-9b

4. Provide an incentive for the men to work fast and steady without wasting time.

5. Provide the necessary management and supervision to properly direct the activities of the collection crews.

I would like to outline to you the work we have done to date which has led us to the above recommendations. To begin, we drew detailed maps of all of your present routes. Each driver was invited to describe in detail how his route was collected. We drew this data on maps with colored pencils showing the path that was traveled for collection and dead heading, where stops were made for coffee breaks and lunch periods, beginning and ending points, plus which side of the street was collected when not collecting from both sides. We then selected certain routes and assigned a technician to follow the crews that were collecting these routes. The crew was of course informed of this procedure in advance and shown all of the data collected. The technician recorded activity in detail on a field form designed for that purpose. The data collected included the exact streets and alleys driven; all maneuvers including all turns and stops and backing movements; the time and mileage per collection block; and number of containers emptied per block. He also recorded time and mileage for all non-collection activities including haul to the land fill site, driving to and from the yard, coffee and rest breaks, lunch periods and all other delays whatsoever.

Once the routes were followed, data was obtained showing the number of dwelling units per block which corresponded to the blocks followed. We are developing data which will be used to set time and quantity standards for collection from various types of neighborhoods and various conditions such as carryout vs. alley collections. The collection standards coupled with work schedules and necessary driving time will be used to establish proper routes which represent a reasonable day's work.

We have found that a fantastic amount of time is spent in delays for rest breaks, coffee breaks, smoke breaks and lunch periods. Sometimes these delays represent almost as much time as the time spent collecting garbage.

Anyone who has observed a garbage collection crew at work can appreciate that the work is not easy. When picking up garbage the men do manual labor involving much walking, lifting and carrying. There appears to be no end to the process. As soon as one can is emptied and carried to the truck there is another to do. Without stops from time to time, a good crew could work themselves into a state of exhaustion. There are however, many places where

EXHIBIT 3-9c

brief built-in stops and rest periods are provided and where a few extended rest periods are also provided. Most routes have many places where the collection crews ride the truck from one point on the route to another point either from stop to stop, around corners or while dead heading. These rest periods vary from a few seconds to a few minutes each. The extended periods consist of the driving trip from yard to first stop in the morning, trips to and from the landfill site with a full load of garbage, the trip at the end of the day from the landfill site to the yard, and the lunch period.

Since it takes several hours to fill a truck and since the work is physically taxing, we believe short rest periods should be not only allowed but scheduled and encouraged. We believe therefore that after approximately one hour's work the crew should take a short break. They will feel better for doing this and also produce more work over an entire day. This break should be taken by simply stopping work where they happen to be at the appointed hour, and not leaving the route for the purpose of going to a coffee house in the neighborhood. A brief rest for the sake of resting is beneficial. A longer coffee break which may have social benefits does not result in a benefit to the task to be accomplished.

A scheduled lunch period should be allowed with time to go to a place to wash and eat. Currently a 30 minute period is scheduled and the crews are allowed to go to the closest fire station or City park to eat. This appears to be appropriate and popular with the men, however, the lunch periods are seldom restricted to 30 minutes. It should be agreed that either 30 minutes are to be used and then limit the crews to this time, or schedule a longer period for lunch and extend the work day to cover this period.

Under the current procedure the men are scheduled to work from 7:00 A.M. to 3:30 P.M. each day with a 30 minute lunch time. As a practical matter, crews arriving at the landfill site after 2:30 P.M. cannot be economically diverted to other work. As a result they are held at the landfill site until approximately 3:00 P.M. and then released to drive back to the yard, fuel their vehicles and be released for the day. The men know this and many of them plan their day accordingly. We believe this is extremely wasteful, bad on morale and accomplishes nothing. We recommend that the routes be planned and the work scheduled to do a good day's work each day and then allow the men to go home when the work has been accomplished. This is generally known as the "Task" or "Incentive" Plan.

To create an incentive, the route should be of such a size that the crew can, by working steadily, complete the route within the time allotted with approximately 40 minutes off at the end of the day.

The crew that wishes to hustle a little faster can earn as much as one hour off. The crew that drags gets little or no incentive. The key of course is to lay out a proper day's work. We will lay out several such routes and teach your supervisors to use standards we will develop to lay out the remaining routes. It is necessary for your men to know how to do this because route standards and conditions change constantly and require periodic adjustment if a properly managed economical system is to be maintained.

Wasting time is not only expensive in direct labor and equipment cost, but it also has bad side effects. The men are not proud to be a part of a "goof off" team. They have no respect for the City, their department or their supervisors for allowing such a condition to develop and be maintained. Their morale is bad, their sense of loyalty is reduced and their turnover rate is higher than necessary.

One must also realize the social and practical problems associated with hiring, retaining and supervising garbage collection crews. The pay scale is near the bottom of the schedule for men doing physical labor. It has been said that "no one has ever asked for a transfer to the garbage department". This is probably not true but does illustrate the problem. The work is not easy and the image of the garbage man is bad. We will discuss improvement of the image at another time. The men normally employed in this work do not usually have the higher educations nor are they as likely to be as steady in their jobs as some of the other classifications. These men must have better supervision and the job should be given every consideration to improve its image, morale and incentives.

The matter of efficiency in collecting garbage is more important than most people realize. This year the adopted budget for garbage collection is approximately $712,000, which is one of the highest single items of expenditure. Generally, budget officers assume that garbage must be collected, which is true, and that the department must have whatever funds they request for men and equipment to do the job, which is not true. The garbage collection cost can be significantly reduced if the same amount of services to the public is maintained or more service to the public can be provided per dollar spent.

A route which we followed can be cited as an example of the present situation. This is not the average or mean route, because we have not completed our work. It can, however, be said to be not unusual.

EXHIBIT 3-9

This route was recorded to consume the times shown in the following summary:

1. Collection Time*	3:59	=	239 Minutes	=	51.5%
2. Haul Time**	1:39	=	99 Minutes	=	23.3%
3. Delay Time***	2:06	=	126 Minutes	=	27.2%
Sub-Total	7:44	=	464 Minutes	=	100.0%
4. Other****	:46				
	8:30				

* Time spent on route collecting garbage or driving between stops.

** Time spent to the route from yard, to and from landfill site, from site to yard.

*** Time spent not on collection or haul, includes lunch, breaks, etc., plus :18 at end of day when allowed to go home.

**** Time spent in special activity such as on next day's route (:27) and special tasks for engineering survey (:19).

It can be seen from the example and from the foot notes that not only were they able to do their day's work, but they were able to take considerable delays and also do 27 minutes of the next day's work.

Their day's work to do was inadequate, and the next day's work would probably be even shorter because part was accomplished this day.

EXHIBIT 3-9f

The schedule we would recommend would be something like the following:

Hours	Collection	Haul	Delay	Description
0700				
0715		:15		Trip from yard to first collection.
0815	1:00			Collection.
0820			:05	Rest break.
0920	1:00			Collection.
0925			:05	Rest break.
1025	1:00			Collection.
1055		:30		Haul full load to disposal site and return to route.
1155	1:00			Collection.
1225			:30	Lunch.
1325	1:00			Collection.
1330			:05	Rest break.
1420	:50			Collection.
1450		:30		Haul load to disposal site and return to yard.
1530			:40	Incentive time (go home).
Total	5:50	1:15	1:25	

It can be seen that in addition to three short rest breaks of 5 minutes each and a 30 minute lunch time there is also a total of 1 hour and 15 minutes of hauling time for the crew to rest. At no time would the crew be expected to work more than one hour without a break, not counting any rest they can get while traveling between stops or dead heading between parts of the route.

EXHIBIT 3-9g

Comparing the productive collection time of 5 hours and 50 minutes in the above example to the 3 hours, 59 minute collection time in the first example one can see that 46% more refuse can be collected per crew and still enjoy a 40 minute incentive time. If the crew were willing to increase their pace 5-6%, they could pick up another 20 minutes of incentive time to make it equal to one hour. They could slow down 10 to 12% and still finish within the day's work schedule.

It can be argued that proper management can be applied to the present system with similar results. This, however, would be difficult to accomplish. Certainly the present effectiveness can be drastically improved but the nature of refuse collection work being scattered over a large area is difficult to supervise. Establishing proper route work standards must be done and would be of great benefit, however, there are many ways for a crew to slow down or be delayed which are difficult to supervise. Under the incentive plan, the men and their foreman have a common desire to improve their routes.

There are many details which must be worked out in connection with using the procedures we are recommending. We do not propose to go into all of them at this time, however, we feel that a few of them should be mentioned. The sample days schedule we have used shows the crews returning to the yard at 1450. It is planned that the crew would park their vehicle in the yard without being fueled to avoid the time consuming traffic jam at the fuel pumps.

It is contemplated that a man would be assigned to the night shift who would fuel all of the vehicles using the fuel tank truck and fuel all the vehicles where they are parked. He would also wash the vehicles scheduled for that night after the fueling was completed.

During the winter a man must be assigned the task of starting all vehicles in the morning and allowing them a warm up period prior to 0700 when the crews start their work. One person doing this work can save many crew hours of lost time. Not only is this a direct potential saving in payroll expense and reduced wear and tear on equipment due to a proper warm up, but it is also necessary to prevent delays which would interfere with the performance of the days scheduled work.

To complete the most collection work in the shortest period of time and to allow the crews to earn a maximum amount of incentive time, it is recommended that the work rules outlined below be established for normal routine conditions.

1. At the beginning of the day, collection crews shall proceed directly from the yard to the point of first collection where they will begin collection of garbage.

2. Crews shall remain on their routes and shall follow the prescribed path at all times except when proceeding to and from the place of disposal and the yard and except for the lunch period.

3. One 30 minute lunch period, which starts when the crew leaves their route and ends when they have returned to their route, may be taken. Crews may leave their route during this period and drive to the closest City Fire Station or City Park at their option.

4. At the end of any full hour's collection time the crew may take, and they are encouraged to take, a 5 minute rest break; except when it is time to go to lunch or the truck is full and they should proceed to the place of disposal.

5. When the route has been collected the crew shall proceed directly to the place of disposal and then directly to the yard, at which time they normally will be dismissed for the day.

6. If one or more of the collection crews in the same District have been delayed for any reason, the District Foreman may direct one or more of the other crews in that District to assist a delayed crew with the completion of the delayed crews collection.

7. When a crew is required to work more than the 8 hours per day plus lunch time, they shall receive compensatory time off at another time at the rate of 1½ hours of compensation time for each one hour of time worked in excess of the 8 hours plus lunch time.

The recommended five part solution to the problems discussed in this summary will require the overcoming of some obstacles. The following is a general listing of the parts to the solution and an evaluation of the potential obstacles:

1. The division of the City into Districts is a technical and administrative procedure which presents no legal, political or labor/management obstacles.

2. The layout of proper routes is also a technical and administrative matter without legal, political or labor/management obstacles.

EXHIBIT 3-91

3. The establishment of new work rules are simple in technical and administrative matters; however, there is a labor/management consideration which must be considered. We believe they can be worked out in connection with the incentive plan.

4. The incentive plan is the key to the success of the system, but also contains the largest number of potential problems. Currently, the working hours are established by provisions of the Municipal Code. It is possible that revisions to the code may be necessary. There may also be problems with other groups of City workers. Although we cannot imagine labor/management problems on this issue, it would have to be considered as a possible obstacle.

5. The necessary proper management and supervision are administrative matters which will require careful consideration. This item will be discussed in detail at another time; however, no serious problems are anticipated.

Whatever the problems and obstacles, we believe the recommendations are sound and represent the greatest potential benefits to the City.

EXHIBIT 3-91

Exhibit 3-10

COMPUTATIONS FOR 2-MAN VS 3-MAN COLLECTION CREWS

1. Truck Cost: \$3,000 per yr ÷ 2080 = \$1.44 per hour.

2. Labor Cost: Average of \$3.40 per hour.

3. 3-man crew cost per day: 3 x 3.40 x 8 + 1.44 x 8 = \$93.14.

4. 2-man crew cost per day: 2 x 3.40 x 8 + 1.44 x 8 = \$65.94.

5. Notation:
   a. X = Rate of collection (#/min.) of a 3-man crew.
   b. Q = Some decimal so that,
   c. QX = Rate of collection (#/min.) of a 2-man crew.
   d. D = Distance in minutes driving time from landfill site and from garage.
   e. C = Time spent in collection (minutes).

6. Assume the following typical day, 3-man crew:
4 breaks @ 5 min. ea. = 20 min.
2 hauls to route @ D min. ea. = 2 D min.
2 hauls to L. F. site @ D min. ea. = 2 D min.
2 unloading at site @ 5 min. ea. = 10 min.
1 haul to garage = 9 min.
Incentive time = 40 min.
Time spent collecting = C_3
Total day = 8 hours = 480 min.
C_3 = 480 - 79 - 4D = 401-4D.

7. Assume the following typical day, 2-man crew:
4 breaks @ 5 min. ea. = 20 min.
1 haul to route in A. M. = D min.
1 haul to landfill site = D min.
1 time to unload = 5 min.
1 haul to garage = 9 min.
Incentive time = 40 min.
Time spent collecting = C_2
Total day = 8 hours = 480 min.
C_2 = 480 - 74 - 2D minutes
= 406 - 2D minutes

8. At the break-even point, the cost per pound collected would be equal, therefore:

$$\frac{93.14}{X \times C_3} = \frac{65.94}{QX \times C_2}$$

$$\frac{93.14}{X \times (401 - 4D)} = \frac{65.94}{QX \times (406-2D)}$$

or

$$203Q - DQ + 1.42D = 141.95.$$

9. The time D is a function of Q. By assuming value of Q the break-even driving time to a landfill site can be determined.

Where Q =	.66	D = 10.5
	.65	D = 1.0
	64	D = 15.5
	.63	D = 18.0
	.62	D = 20.0
	.61	D = 22.5
	.60	D = 24.5
	.59	D = 26.5
	.58	D = 29.0

10. We have assumed Q = .61 which means the 2-man crew is considered to be 61% as productive as a 3-man crew. (If they were 100% as efficient, they would be 66.6% as productive).

11. For a Q of .61 the break-even driving time would be 22.5 minutes. If the driving time from the route to the landfill site is more than 22.5 minutes each way, the two man crew is more economical; if less than 22.5 minutes the reverse is true.

EXHIBIT 3-10B

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HENNINGSON, DURHAM & RICHARDSON
VEENSTRA & KIMM

Re: METROPOLITAN DES MOINES
SOLID WASTE STUDY #3170106

ADDRESS REPLY TO:
3555 Farnam Street
Omaha, Nebraska 68131
January 25, 1968

Mr. Leo Johnson
Director of Public Works
City of Des Moines
City Hall
Des Moines, Iowa

Dear Mr. Johnson:

In our letter to you dated June 30, 1967, we recommended that the City of Des Moines take immediate steps to improve the operation of their two landfill operations. Part of the suggestions have been placed into operation. We also recommended new and better equipment and suggested a fee be established to pay for the new equipment and additional expense.

When we discussed this matter about two weeks ago, you indicated you were ready to pursue this new equipment and fee matter and requested a new estimate of fees. Harold Smith and I worked up the required equipment. Harold then estimated the cost of the new equipment, amortization, maintenance and other costs of the new operation. He sent this information, which I have used to set forth my ideas of how to structure a new, simple and interim fee system.

I believe there is enough information contained in this letter to allow you to proceed. I have prepared an attachment showing the figures which are explained in the following paragraphs.

It is assumed that the vehicles counted during the survey week are sufficiently representative of the annual volume as to be used directly. For this purpose, no seasonal variation was applied, nor was any annual change made from the time of the survey week through the several years in this analysis. The purpose of this analysis is to determine approximately what the new capital equipment costs and operational costs will be and how they can be financed.

EXHIBIT 4-1

It is further assumed that the time remaining at this site would not warrant the expenditure necessary to install the scale systems required to charge fees based on tonnages. If tonnages are removed from consideration and the fees are designed to provide financing for interim improvements and operation, we recommend that a simple fee system be installed which will produce the required revenues. We recommend a fee be charged for pick-up trucks and light trailers at $1.00 per vehicle and for other trucks and trailers at $2.00 per vehicle. No charge would be made for City Vehicles or for automobiles. This fee is extremely low when compared to other communities, primarily because there are no land costs and existing facilities will be used for the remaining life of the sites. The number of vehicles are shown in Part A of the attachment.

The revenue to be produced from fees is shown in Part B. This is self-explanatory except for the diversion. We have estimated that approximately 25% of the disposed waste will be diverted to some place other than the two City sites. This number is largely an enlighted speculation, but appears reasonable. As shown in Part B, an annual revenue of $287,000 can be expected from non-City trucks using the two sites. As shown in Part C, an annual benefit of $32,000 worth of disposal service will be supplied to the City without fees; however, this same sum is suggested as a budgeted item in Part "G".

The new operational costs have been estimated by Harold Smith based on quantities and equipment suggested by the consultant. Likewise, the new equipment cost, amortization and rentals have been estimated by Harold using the department records and procedures. We have used these costs as he produced them, except for increasing the miscellaneous costs from $2,000 to $12,000.

The costs of operations under new conditions are summarized in Part D and the cost of the new equipment is shown in Part E. It should be noted that the equipment rental in Part D includes the maintenance, repair and amortization of equipment. The full price of the equipment will be returned to the garage fund through this amortization. It is customary to buy this equipment through a budget item when the equipment is first purchased and then build the price of a replacement through rentals so the equipment can be replaced, when it is worn out. Thus, there are always funds for a new one after the original purchase. In this case, the cost of the equipment is not budgeted. It is suggested that the equipment be purchased with funds borrowed from the equipment fund. The rentals will replace it, but it is also proposed to replace the originally borrowed funds through a "surplus" or "reserve for debt" accumulated each year.

EXHIBIT 4-10

The costs for each of three (3) years are shown in Part F. The first year, 1968, shows 6 months of present operations and 6 months of new operations using the new equipment. The next two years 1969 and 1970 show the costs for a full year.

Revenue for 1968 through 1970 is shown in Part G. The first year includes the 1968 budget and 6 months of fees. The second and third years contemplate budgets of $32,000 which is equal to the fees for City trucks if fees were charged for these vehicles. The reduction in budget from the present $153,000 to $32,000 is equal to $121,000 per year. A comparison of costs and revenue and the resulting reserve or surplus expected each year is shown in Part H.

New equipment valued at $190,000 is required for the new and improved operations. This equipment has an annual depreciation of $31,700, when considering trade-in value and depreciation.

Part I shows the value of the equipment at the end of the year, the debt to the garage fund, the equity in the equipment earned to the end of the year and equity gain this year. It can be seen that the surplus or reserve is reducing the debt to the garage fund much faster than the equipment is depreciating.

At the end of the first year, which represents only 6 months of the new operation, the equipment has depreciated from $190,000 to $174,000 in value. When the surplus or reserve is applied to the purchase debt, the City has only a $117,500 investment in it and the equipment is being replaced through the amortization part of the rental rate. At the end of 1968, the City gained a $56,500 equity in the equipment.

A similar analysis is shown for 1969 and 1970. Under the conditions shown, the original equipment cost of $190,000 would be returned to the garage fund 7 months into the third year or after approximately 25 months of operations.

It is doubtful that you could be using this equipment at this site during the entire time shown to pay off the original investment. It can be seen, however, as explained above, that the value of the depreciated equipment is always greater than the outstanding debt. If, at the end of 1968, the City wished to discontinue this equipment they would have $174,000 worth of equipment with a debt of $117,500 plus that portion of the rental applied to replacement. They could sell it or use it for other City operations with no loss and probably a profit.

EXHIBIT 4-1b

If the City would wish to eliminate their budgeted amount completely, they could do so by raising the fee or cutting the surplus or reserve. They could also charge more for packer trucks. I suggest you try this approach and if you need more information, I will get it for you.

Very truly yours,

HENNINGSON, DURHAM & RICHARDSON
VEENSTRA & KIMM

By R J Peterson
R. J. Peterson, P.E.
Project Engineer

Attachment

RJP:ea

cc: Veenstra & Kimm
Attn: Mr. Glenn

EXHIBIT 4 - 1c

ATTACHMENT

A. VEHICLES PER WEEK

	DM #1	DM #2	Total
Total Vehicles	3,119	2,073	5,192
Autos	466	77	543
City Packers	181	0	181
Other City Trucks	52	82	134
Vehicles other than Autos and City Vehicles	2,420	1,914	4,334
Pick Up Trucks	1,161	700	1,861
Light Trailers	134	78	212
Other Trucks	1,125	1,136	2,261

B. REVENUE FROM FEES

Pick-up Trucks	1,861		
Light Trailers	212		
Sub-Total	2,073	@$1.00/Vehicle =	$2,073/Wk.
	2,261	@$2.00/Vehicle =	$4,522/Wk.
Total			$6,595
Less Diversion Est. @ .25			- 1,083
			$5,512/Wk.

Annual Revenue $5,512 x 52 = $287,000/Yr.

C. VALUE OF FREE SERVICE TO CITY VEHICLES

Packers, City	181
Other, City	134
Sub-Total	315 per week x 52 = 16,000 per Yr.
	16,000 Vehicles @ $2.00 = $32,000/Yr.

D. COST OF NEW OPERATION

Personnel	$137,000/Yr.
Equipment Rental	96,000
Miscellaneous Expense	12,000
	$245,000/Yr.

E. EQUIPMENT COST AND DEPRECIATION

Capital Cost of New Equipment Required	$190,000
Depreciation on New Equipment/Yr.	31,700

EXHIBIT 4-1d

F. COST

1.	1st Yr. 1968	
	6 Mo. Present Operation (153,000 + 2)	$ 76,500
	6 Mo. New Operation (245,000 + 2)	122,500
	Special 1st Yr. Improvements	25,000
	Total Cost	$224,000
2.	2nd Yr. 1969	
	1 Yr. New Operation	$245,000
3.	3rd Yr. 1970	
	1 Yr. New Operation	$245,000

G. REVENUE

1.	1st Yr.	
	Present Budget	$153,000
	6 Mo. Fees (287,000 + 2)	143,500
	Total Cost	$296,500
2.	2nd Yr.	
	New Budget	$ 32,000
	Fees 1 Yr.	287,000
	Total Cost	$319,000
3.	3rd Yr.	
	Same as 2nd Yr.	$319,000

H. COST VS. REVENUE

		Cost	Rev.	Reserve or Surplus
1.	First Year	$224,000	$296,500	$ 72,500
2.	Second Year	245,000	319,000	74,000
3.	Third Year	245,000	319,000	74,000

EXHIBIT 4-1a

I. EQUIPMENT CAPITAL DEBT

1.		Original Cost of Equipment	$190,000
2.		Depreciation per Year	31,700
3.		First Yr. (6 Mo. of New Equip.)	
	a.	Depreciation 6 Mo. (31,700 + 2)	16,000
	b.	Value of Equipment at end of 6 Mo. 190,000 - 16,000	174,000
	c.	Cost less surplus (debt) 190,000 - 72,500	117,500
	d.	Equity gain in Equip. this 6 Mo.	$ 56,500
4.		Second Year	
	a.	Value of Equipment end of Yr. 174,000 - 31,700 =	$142,300
	b.	Debt Less Surplus (New Debt) 117,500 - 74,000 =	43,500
	c.	Equity in Equip. at end of Yr. 142,300 - 43,500 =	98,800
	d.	Equity in Equip. Gain this Yr. 98,800 - 56,500 =	42,300
5.		Third Year	
	a.	Value of Equip. End of Yr. 142,300 - 31,700 =	$110,600
	b.	Debt Less Surplus 43,500 - 74,000	-(30,500)
	c.	Equity in Equip. at end of Yr. 110,600 - (-30,500) =	141,100
	d.	Equity in Equip. gain this Yr. 141,100 - 98,800 =	42,300

EXHIBIT 4-11

(Estimate Received from Harold Smith - January 22, 1968
Attached to letter to Mr. Johnson dated - January 25, 1968)

Proposed Landfill Dirt Operation

Stagger truck starting time to avoid stockup at beginning of day.

Loader to have two (2) cubic yard bucket.

Loading time per truck;

50 seconds per cycle x 6 cycles per load = 300 seconds
300 seconds = 5 minutes
Dump time per truck = 3 minutes
Maximum travel time round trip = 20 minutes
Total Time per truck 28 minutes

8 hr. 30 min. day
- 30 min. for lunch
7 hr. 60 min.
- 30 min. coffee break
7 hr. 30 min. = 450 minute working day

$$\frac{\text{450 minute working day}}{\text{28 minute total time}} = \text{16 loads/truck}$$

Based on five (5) trucks
5 trucks x 16 loads x 10 cu. yd. = 800 cu. yds/day

Landfill Operation needs 130,000 cu. yds/year
Based on hauling 5 days/week trucks would have to provide 510 cu. yds/day

EXHIBIT 4-19

Proposed Landfill - New Equipment Needs

	Description	Basic Cost	Guaranteed Maintenance Cost (3 yr)	Total Cost
1.	D8H Class Dozer	60,000	$12,000	$72,000
2.	977 Class Loader	35,000	8,000	43,000
3.	Tandem Axle 10 cu. yd. Trucks (5)	75,000		75,000
				$190,000

	Initial Cost	Trade-In 3 Yr.	3 Year Depreciation	1 Year Depreciation
D8H	$72,000	$36,000	36,000	12,000

Depreciation	$5.77/hour	
Maint. Lubrication - Fuel	$2.00/hour	
	$7.77 hour	
Overhead	1.33/hour	(17%)
Hourly Rental Rate	$9.10/hour	

	Initial Cost	Trade-In 3 Yr.	3 Year Depreciation	1 Year Depreciation
977	$43,000	$21,500	$21,500	7,167

Depreciation	$3.45/hour	((2080 hours)
Maint. Lubrication - Fuel	1.75/hour	
	5.20	
Overhead	.90	(17%)
Hourly Rental Rate	$6.10/hour	

Tandem Axle 10 Cu. Yd. Trucks (diesel)

Initial Cost	Trade-In 5 Yr.	5 Year Depreciation	1 Year Depreciation
$15,000	2,500	12,500	2,500

Depreciation	$1.20/hour
Maint. Lubrication - Fuel	1.20/hour
	$2.40/hour
Overhead	.41
Hourly Rental rate	$2.80/hour

EXHIBIT 4-1h

Proposed Landfill - Personnel Needed

1.	Landfill Foreman (2080)	2 x 7,684.04	=	$15,368.08
2.	Laborers (2040)	7 x 5,834.40	=	40,840.80
3.	Laborers (Casual) (2080)	2 x 5,948.80	=	11,897.60
4.	Medium Equipment Operator	4 x 7,684.04	=	30,736.16
5.	Light Equipment Operator	1 x 6,670.04	=	6,670.04
6.	Truck Drivers (2040)	5 x 6,384.04	=	31,920.20
				$137,432.88

Equipment Rental

1.	Case Loader			3,700.00
2.	D 10 Dozer	2,040 hours @$9.50	=	19,380.00
3.	D 11 Dozer	2,040 hours @$6.50	=	13,260.00
4.	New D8H Class Dozer	2,040 hours @$9.10	=	18,564.00
5.	New 977 Class Loader	2,040 hours @$6.10	=	12,444.00
6.	Trucks (5)	10,200 hours @$2.80	=	28,560.00
				$95,908.00

Misc.

Maintenance of Building	$ 1,000.00
Pick-Up Truck	1,000.00
	$ 2,000.00

Total Cost of Proposed Landfill First Year

Personnel	$137,432.88	
Equipment Rental	95,908.00	
New Equip. Purchase	190,000.00	
Misc.	2,000.00	
	$425,340.88	
Budgeted 1968	152,872.00	
	$272,468.88	Additional Needed

EXHIBIT 4-11

EXHIBIT 4-2

COST OF ONE SANITARY LANDFILL VS. TWO SITES

In Part Four, Section G it was shown that there was no suitable location within several miles of the "Waste Centroid Total Study Area". It was necessary to consider more than one site.

The Study Area is large enough to operate two large sites in lieu of one giant site without a serious increase in unit cost.

In the cost estimates shown in Table 4-4 for the two sites which were recommended, a total annual cost of $573,640 is estimated for the 1968 quantities. If a single site was selected these costs could probably be reduced by approximately $50,000 per year; however, the additional haul cost from the side of the study area without the site would soon exceed this potential paving. For example, at $6.00 per haul-hour, the $50,000 would be consumed in 8,300 haul hours. If 150,000 vehicle round trips were made per year, to consume 8,300 additional haul hours, only 3.3 minutes of extra round trips would be required. (8,300÷ 150,000) x 60.

It is apparent that two sites can easily be justified.

EXHIBIT 5-1

INTERGOVERNMENTAL AGREEMENT CREATING THE METROPOLITAN AREA SOLID WASTE AGENCY

By virtue of this agreement made and entered into by, between and among the Town of Altoona, Iowa, the City of Ankeny, Iowa, the Town of Bondurant, Iowa, the Town of Carlisle, Iowa, the Town of Clive, Iowa, the City of Des Moines, Iowa, the Town of Grimes, Iowa, the Town of Norwalk, Iowa, the Town of Pleasant Hill, Iowa, the County of Polk, Iowa, the City of Urbandale, Iowa, the County of Warren, Iowa, the City of West Des Moines, Iowa, and the City of Windsor Heights, Iowa, (all parties being hereinafter called the "Municipalities"), there is hereby formed the Des Moines Metropolitan Area Solid Waste Agency (hereinafter called the "AGENCY"), consisting of elected representatives of the governing bodies of the Municipalities which said Municipalities represent a majority of the local governmental jurisdictions comprising the Des Moines metropolitan area.

WITNESSETH:

I.
AUTHORITY

The Municipalities enter into this agreement under and by virtue of the power to do so granted by Chapter 28E, Code of Iowa, 1966.

II.
PURPOSES

1. The purposes of the AGENCY are as follows:

   (a) To provide for the economic collection and disposal of all solid waste produced or generated within each member city, town, and that portion of each such county as the Board of Supervisors shall determine to be part of the metropolitan area, comprising the Municipalities.

   (b) To cooperate with local, State and Federal public health agencies in preventing the contamination and pollution of the land, water and air resources of the area, through the control, collection and disposal of solid waste.

   (c) To engage such employees and provide offices, equipment, machinery, buildings and grounds as are necessary to adequately perform the functions of the AGENCY.

(d) To contract with member cities, towns and counties and with public or private persons, firms or corporations for the collection and disposal of solid waste, and collect payment for such services, and to receive and expend State, Federal and private grants and other monies which may be made available, to the extent permissible under applicable State and Federal laws, and under the rules hereinafter set forth.

III.
ORGANIZATION

(a) The Governing body shall be designated as the AGENCY BOARD (hereinafter called the "Board"), consisting of an elected representative of the governing bodies of each participating governmental jurisdiction, or his designated substitute, which substitute shall be approved by the body he represents.

(b) Each member of the Board shall have one vote for each 50,000 population or fraction thereof, residing in the government jurisdiction he represents. Such population shall be ascertained from the most recent Federal Census for that jurisdiction.

(c) A quorum shall consist of a majority of the entire Board membership, regardless of the number of votes held by each member present.

(d) The Chairman and the Vice-Chairman of the Board shall be elected by majority of Board membership and shall serve for a term of one year or until their respective successors in office are chosen. The incumbent in each said office may succeed himself.

(e) The Board shall hold at least one meeting during each quarter of the year on dates and at places which shall be determined by the Board. Special meetings may be held at the call of the Chairman, Vice-Chairman or majority of the membership of the Board.

(f) The Board shall hire a Director and such other supervisory, clerical, and other personnel as are necessary to carry out the functions of the AGENCY. The Board shall fix their compensation and benefits, and shall approve all personnel rules and regulations pertaining thereto.

(g) The Director shall be the Secretary and Treasurer of the AGENCY and shall have the authority, duties and obligations normally associated with these offices, including but not limited to the receipt and disbursement of funds and the preparation and submission of quarterly and annual financial reports to the Board.

(h) The Board may employ legal counsel, who may be a paid employee of one of the members, and who may receive compensation set by the Board for the performance of his duties.

IV.
DURATION

1. It is the intention of this agreement that the AGENCY be a permanent organization. Additional municipalities may be added to the membership of the AGENCY upona three-fourths vote of all of the members of the Board.

2. In the event an additional municipality shall apply for membership in the AGENCY and said application is considered and approved by the then existing Board, then said municipality may be added to the membership, provided however, that said additional municipality as a condition of membership agrees to abide by the terms of this agreement as set out herein and possess legal power and authority to so do.

V.
POWERS

1. The Municipalities delegate the following powers to the AGENCY and Board:

(a) To cause the collection and disposal of solid waste materials determined by the Board to be appropriate.

(b) To contract with all levels of government, other public agencies, private agencies and private individuals, toward the accomplishment of the stated purposes of the AGENCY, within the limits authorized by law.

(c) To receive funds from each member Municipality as payment for providing collection and disposal of domestic refuse from residents therein; provided however, that in lieu of receiving such funds from member municipalities, it shall have the power to bill individuals directly for payment for collection services and to receive such payments, for and on behalf of the municipalities.

(d) To charge a disposal fee to be collected from all such users of the AGENCY'S disposal facilities as the Board shall direct.

(e) To hire employees, fix their compensation, benefits, personnel rules and regulations, and terminate their employment.

(f) To purchase, lease, receive as gifts or donations, or otherwise acquire all land, buildings, equipment and supplies necessary to carry out the functions of the AGENCY, and to dispose of the same.

(g) To make or cause to be made studies and surveys necessary to carry out the functions of the AGENCY.

(h) To contract with and compensate consultants for professional services including but not limited to architects, engineers, planners, lawyers, accountants, rate specialists, and all others found necessary to the stated purposes of the AGENCY.

(i) To issue revenue bonds for the purchase of land and equipment and erection of buildings and other improvements, and to provide for their retirement.

(j) To prepare and recommend to member Municipalities local ordinances governing refuse collection transportation and disposal, regulation of private collection haulers, land use regulations, sanitation, burning of private or public wastes, incineration standards and such other regulations as may from time to time be required.

(k) To exercise any and all powers relative to the efficient collection and disposal of solid waste available under then existing laws to each member Municipality.

(l) To prepare by-laws, rules and regulations, fee schedules, and entrance and termination forms and procedures for membership in the AGENCY.

(m) To provide for a system of budgeting, accounting, auditing and reporting of all AGENCY funds and transactions, for a depository, and for the bonding of employees.

(n) To consult with representatives of Federal, State and local agencies, departments and their officers and employees and to contract with such agencies and departments.

(o) To exercise any and all other powers consistent with the stated purposes of the AGENCY available under then existing law to each member Municipality.

VI.

TECHNICAL COOPERATION FROM MUNICIPALITIES

1. The Municipalities agree to respond to reasonable requests to make local records available to the AGENCY staff and its consultants or employees for the purposes of this agreement, and to assure that engineers, architects and consultants hired by the Municipalities release materials, data and other pertinent items paid for by public funds to the AGENCY staff to aid in the efficient and effective accomplishment of such purposes.

EXHIBIT 5-1c

VII.
FINANCING

1. The Board shall prepare a budget based on calendar years for the operation of the AGENCY to be adopted in June of the year preceding the budget year.

2. The Board shall request each Municipality to provide in its budget for its share of the AGENCY budget.

3. The Board shall annually adopt a percentage formula, based on population, as shown in the last completed Federal census, for the purpose of allocating the portion of the AGENCY budget each Municipality will provide.

4. The share of each budget from each Municipality shall be due and payable to the Treasurer of the AGENCY in quarterly payments to be made within 30 days after the beginning of the quarter of the AGENCY'S budget year.

5. Special appropriations shall be made by the parties hereto for funding the operation of the AGENCY prior to the establishment of the budget cycle.

6. Any special or budgetary appropriation adopted by the AGENCY shall be a membership requirement of each and every Municipality and shall upon the Municipality's contracting with the AGENCY therefor constitute a legal liability on the part of such Municipality. The failure of a Municipality to pay over to the AGENCY the allotted share of an AGENCY budget may be considered a momentary withdrawal of that Municipality and a default of this Agreement.

VIII.
SUSPENSION OF VOTING RIGHTS AND SERVICES

During a period of delinquency by a Municipality in the payment to the AGENCY of its share of a budget and before such delinquency is determined a voluntary withdrawal, such Municipality shall not be entitled to the services of the AGENCY, nor shall the Municipality be entitled to vote on matters coming before the Board, unless such delinquency shall be waived for voting purposes by a three-quarters vote of the remaining members of the Board.

IX.
DISSOLUTION

1. In the event of the withdrawal of any Municipality from the AGENCY such withdrawing Municipality shall be entitled to a pro-rata share of the value of the real and personal property of the AGENCY. Such share shall be calculated as the percentage of the then value of said property based on the ratio of the funds the withdrawing Municipality has provided to the AGENCY during the period of this agreement to the sum of all funds provided by all Municipalities. Funds for the payment of the pro-rata share of such property value shall be provided for in the next succeeding AGENCY budget cycle and shall be

EXHIBIT 5-1d

payable within six months of the beginning of the budget year in which the item appears. A withdrawing Municipality may waive its pro-rata share of any real or personal property in the possession of the AGENCY.

2. The AGENCY shall be completely dissolved and this agreement terminated only upon the affirmative three-quarters majority vote of the Board.

3. In the event of complete dissolution of the AGENCY, any real or personal property shall be sold and the proceeds prorated among the Municipalities at the time of dissolution on the basis of the sum of the portions of the budget for the AGENCY provided by them for and during the period of this agreement. The current budget year shall be used as one of the years in the calculation if all Municipalities have made their proper contribution. If all members have not made their proper contribution, the balance remaining of funds collected during the current year shall be refunded to the contributors before determining the value of the assets of the AGENCY at dissolution, and said year shall not be used in calculating the shares.

X.

MANNER OF ACQUIRING AND HOLDING PROPERTY

1. The Board may lease, purchase, or acquire by any other means, from members or from any other source, such real and personal property as is required for the operation of the AGENCY and the carrying out of the purposes of this agreement. The Board shall maintain title to all such property in the name of the AGENCY and shall require the Secretary to maintain an inventory. Property, materials and services shall be acquired or disposed of only upon a majority vote of a quorum attending a duly called Board meeting, provided however, that by the same vote, the Board may authorize the Director to expend such funds as the Board may direct for other authorized purposes of the AGENCY.

EXHIBIT 5-10

EXHIBIT 5-2

PROPOSED REFUSE DISPOSAL ORDINANCE FOR CITIES AND TOWNS CONTRACTING WITH THE METROPOLITAN SOLID WASTE AGENCY

Ordinance No. ____

AN ORDINANCE PROVIDING FOR MUNICIPAL DISPOSAL OF GARBAGE AND REFUSE; DEFINING TERMS; PRESCRIBING RULES AND REGULATIONS THEREFOR; REGULATING THE PRIVATE DISPOSAL OF GARBAGE AND REFUSE; PROVIDING FOR THE LICENSING AND REGULATION OF PRIVATE LANDFILL OPERATORS AND DISPOSAL SITES; PROVIDING PENALTIES FOR VIOLATION THEREOF; AND REPEALING ORDINANCE NO. _______ AND ALL OTHER ORDINANCES AND PARTS OF ORDINANCES IN CONFLICT THEREWITH.

BE IT ORDAINED BY THE CITY (TOWN) COUNCIL OF THE CITY (TOWN) OF ______________________________:

Section 1. For the purpose of this Ordinance the following definitions shall apply:

1.1 "Agency" shall mean the Metropolitan Area Solid Waste Agency.

1.2. "Garbage" shall mean any and all refuse from food incidental to its preparation or use for human consumption.

1.3 "Refuse" shall mean any and all solid waste from the City (Town) of ____________________________.

Section 2. By virtue of contract dated _______________________, _____, between the City (Town) of _____________________________ and the Agency; the sanitary landfill sites now and hereafter operated by the Agency are hereby designated as the public disposal sites for all garbage and refuse collected within the corporate limits of the City (Town) of ______________________________.

Section 3. The rules and regulations governing the use of the sanitary landfill sites shall be as determined by the Agency to be in the best interests of the general public.

3.1 The landfill sites shall normally be open to the public on such days and hours as the Agency may designate; however, the Agency may alter the days and hours so scheduled to satisfy unusual conditions or emergencies.

3.2 The Agency shall be responsible for the operation of the landfill sites in a manner which will assure sanitary and safe conditions at all times.

3.3 The operation of the landfill sites shall comply with all regulations of all Local, State, County or Federal Agencies, which may have jurisdiction over such operation.

Section 4. No person, firm or corporation shall permanently dispose of garbage or refuse of any kind upon any land within the corporate limits of the City (Town) of ______________________, unless such land has been designated by the Agency as a licensed private landfill site, or a public landfill site; provided, however, that the prohibition contained in this paragraph shall not apply to the deposit of inert wastes, not potentially injurious to health or the public welfare; where permission to make such a deposit has been obtained from the Owner or responsible agent, nor to the filling in or grading of property with earth, mud, ashes or similar materials; providing all other applicable Local and State laws have been complied with.

Section 5. No person, firm or corporation shall deposit any garbage or refuse at any licensed private or Agency landfill site, except in compliance with posted instructions or instructions of an attendant in charge.

Section 6. Certain materials may be excluded from those refuse materials, which may be deposited at an Agency landfill site. These excluded materials may include junk automobile bodies and similar bulky objects, which may require special processing prior to disposal; trees and tree limbs, unless they have been cut into pieces not exceeding t[illegible] feet in length; burning materials or materials containing hot or live coals; hazardous materials; and other materials which the Agency deems necessary to exclude. However, hazardous materials may be deposited upon the receipt of written permission of a responsible official or attendant of the Agency and subject to any special instructions issued with said permission. Hazardous material shall include: explosive materials, materials contaminated by infectious or contagious disease, fly ash or other fine or powdery material, and other material which may present a special hazard to landfill personnel, equipment or to the public.

Section 7. No person, firm or corporation shall operate or permit the operation of a private landfill in the City (Town) of ____________________, for the disposal of garbage or refuse of any kind from any source unless he shall have first applied for and received a permit to do so from the Agency. The issuance of this permit shall be in the manner prescribed by the Agency and subject to all other applicable Ordinances of the City (Town) of ________________________. Application for such a permit shall set forth how the landfill shall be operated and shall include in part: a topographic map of the parcel of land to be used showing location, drainage,

EXHIBIT 5-2

PROPOSED REFUSE DISPOSAL ORDINANCE FOR CITIES AND TOWNS CONTRACTING WITH THE METROPOLITAN SOLID WASTE AGENCY

Ordinance No. ____

AN ORDINANCE PROVIDING FOR MUNICIPAL DISPOSAL OF GARBAGE AND REFUSE; DEFINING TERMS; PRESCRIBING RULES AND REGULATIONS THEREFOR; REGULATING THE PRIVATE DISPOSAL OF GARBAGE AND REFUSE; PROVIDING FOR THE LICENSING AND REGULATION OF PRIVATE LANDFILL OPERATORS AND DISPOSAL SITES; PROVIDING PENALTIES FOR VIOLATION THEREOF; AND REPEALING ORDINANCE NO. ________ AND ALL OTHER ORDINANCES AND PARTS OF ORDINANCES IN CONFLICT THEREWITH.

BE IT ORDAINED BY THE CITY (TOWN) COUNCIL OF THE CITY (TOWN) OF ________________________________:

Section 1. For the purpose of this Ordinance the following definitions shall apply:

1.1 "Agency" shall mean the Metropolitan Area Solid Waste Agency.

1.2. "Garbage" shall mean any and all refuse from food incidental to its preparation or use for human consumption.

1.3 "Refuse" shall mean any and all solid waste from the City (Town) of ______________________________.

Section 2. By virtue of contract dated ______________________, ______, between the City (Town) of ______________________________ and the Agency; the sanitary landfill sites now and hereafter operated by the Agency are hereby designated as the public disposal sites for all garbage and refuse collected within the corporate limits of the City (Town) of ______________________________.

Section 3. The rules and regulations governing the use of the sanitary landfill sites shall be as determined by the Agency to be in the best interests of the general public.

3.1 The landfill sites shall normally be open to the public on such days and hours as the Agency may designate; however, the Agency may alter the days and hours so scheduled to satisfy unusual conditions or emergencies.

3.2 The Agency shall be responsible for the operation of the landfill sites in a manner which will assure sanitary and safe conditions at all times.

3.3 The operation of the landfill sites shall comply with all regulations of all Local, State, County or Federal Agencies, which may have jurisdiction over such operation.

Section 4. No person, firm or corporation shall permanently dispose of garbage or refuse of any kind upon any land within the corporate limits of the City (Town) of ____________________, unless such land has been designated by the Agency as a licensed private landfill site, or a public landfill site; provided, however, that the prohibition contained in this paragraph shall not apply to the deposit of inert wastes, not potentially injurious to health or the public welfare; where permission to make such a deposit has been obtained from the Owner or responsible agent, nor to the filling in or grading of property with earth, mud, ashes or similar materials; providing all other applicable Local and State laws have been complied with.

Section 5. No person, firm or corporation shall deposit any garbage or refuse at any licensed private or Agency landfill site, except in compliance with posted instructions or instructions of an attendant in charge.

Section 6. Certain materials may be excluded from those refuse materials, which may be deposited at an Agency landfill site. These excluded materials may include junk automobile bodies and similar bulky objects, which may require special processing prior to disposal; trees and tree limbs, unless they have been cut into pieces not exceeding ten feet in length; burning materials or materials containing hot or live coals; hazardous materials; and other materials which the Agency deems necessary to exclude. However, hazardous materials may be deposited upon the receipt of written permission of a responsible official or attendant of the Agency and subject to any special instructions issued with said permission. Hazardous material shall include: explosive materials, materials contaminated by infectious or contagious disease, fly ash or other fine or powdery material, and other material which may present a special hazard to landfill personnel, equipment or to the public.

Section 7. No person, firm or corporation shall operate or permit the operation of a private landfill in the City (Town) of ____________________, for the disposal of garbage or refuse of any kind from any source unless he shall have first applied for and received a permit to do so from the Agency. The issuance of this permit shall be in the manner prescribed by the Agency and subject to all other applicable Ordinances of the City (Town) of ____________________. Application for such a permit shall set forth how the landfill shall be operated and shall include in part: a topographic map of the parcel of land to be used showing location, drainage, fencing and access; plans or other suitable evidence of adequate fire protection and provision for control of rodents, insects and litter; agreement to operate the disposal area as a sanitary landfill only; description of method of filling, equipment to be used; source of earth or other suitable cover; agreement to compact and completely cover all garbage and refuse deposited each day, to allow no burning of any material whatsoever, and to promptly extinguish any fires or combustion which may accidently occur or be started by others; agreement to maintain his landfill site and the vicinity in a safe and sanitary manner, to allow no public nuisance, and to provide a responsible person who will be in constant attendance during the hours of active operation; agreement to operate his landfill in accordance with all local, county, state and federal regulations and to permit access to the landfill site by any health officer or governmental representative or agent who may have jurisdiction for the purposes of inspection.

An annual license fee of $100.00 per year shall be paid to the Agency for each location at which a landfill is conducted.

Section 8. If any private landfill operation is found to be conducted in a way detrimental to the health and welfare of the public, or contrary to provisions of this ordinance, the City (Town) and the Agency shall notify the operator in writing of the objectionable conditions and give him a reasonable time to correct said conditions. After proper notice, the Agency is authorized to enter upon the premises and use any of the Agencies forces and equipment, or those of the landfill operator, or hire forces and equipment, to correct the objectionable conditions. The same shall be considered of benefit to the Owner of the land and the cost of such corrective action shall be chargeable to the Owner, and if not paid, shall constitute a lien upon the premises and shall be collected in the same manner as taxes as provided by law.

Section 9. It shall be unlawful for any person, firm or corporation to receive payment of any kind or request payment of any kind for the disposal of any garbage or refuse at a private licensed sanitary landfill site within the City (Town) of ______________________________.

The charging of a fee for the collection and disposal of any garbage or refuse from a customer by a private refuse collector, shall not be construed as a violation of this Section since the disposal is considered to be incidental to the total collection and disposal service, provided however, such collection and disposal shall be conducted entirely by forces and with equipment owned or operated by the private refuse collector.

Section 10. It shall be unlawful for any person, firm or corporation within the City (Town) of ____________________ to sell or offer for sale, or to install or offer to install, any device intended for use as a garbage or refuse burner or incinerator; except when the intended user of such a

EXHIBIT 5-2b

device has secured a license to operate or use such a device from the City (Town) of_____________________, or when the device will be operated by or for the City (Town) of_______________________.

Section 11. It shall be unlawful for any person, firm or corporation to burn or incinerate or permit the burning or incineration of any garbage or refuse within the City (Town) of____________________. This section shall apply to all garbage and refuse as defined, and shall specifically include all waste paper, boxes, market waste, garden wastes, trees, tree limbs, leaves and any and all materials other than materials used as a fuel in a furnace or boiler.

This section shall not apply to any incinerator operated under a license granted by the City (Town) of____________________, or any incinerator operated by or for the City (Town) of___________________________, or any burning conducted under the direction of the Fire Department of the City (Town) of______________________________________.

Section 12. Fees paid to the Agency for the use of the public landfill facilities, shall be in accordance with the posted and published schedule of fees of the Agency, as provided in the contract referred to in Section 2.

Section 13. It shall be the duty of the police department and all police officers of the City (Town) of________________________________, to enforce the provision of this ordinance.

Section 14. Ordinance No. ________and all ordinance or parts of ordinances in conflict with this ordinance are hereby repealed.

Section 15. If any section, subsection, sentence or part of this ordinance is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance.

Section 16. Any person, firm or corporation violating any of the provisions of this ordinance shall upon conviction be subject to a fine of not more than $100.00 or to imprisonment for not more than 30 days.

Section 17. This Ordinance shall be in full force and effect from and after its passage and publication as provided by law.

PASSED AND APPROVED this_______day of__________________________, 19_____.

____
Mayor

Attest:

____
City (Town) Clerk

EXHIBIT 5-2c

EXHIBIT 5-3

PROPOSED REFUSE COLLECTION ORDINANCE FOR CITIES AND TOWNS CONTRACTING WITH THE METROPOLITAN SOLID WASTE AGENCY

Ordinance No. ________

AN ORDINANCE PROVIDING FOR MUNICIPAL COLLECTION OF GARBAGE AND REFUSE; DEFINING TERMS; PRESCRIBING RULES AND REGULATIONS THEREFOR; REGULATING THE PRIVATE COLLECTION OF GARBAGE AND REFUSE; PROVIDING FOR THE LICENSING AND REGULATION OF PRIVATE GARBAGE AND REFUSE COLLECTORS; PRESCRIBING RULES AND REGULATIONS FOR HAULING GARBAGE, REFUSE AND OTHER WASTE MATERIALS WITHIN OR THROUGH THE CITY (TOWN) OF ____________________; PROHIBITING THE DEPOSIT OF LITTER WITHIN THE CITY (TOWN) OF ______________________; PROVIDING PENALTIES FOR VIOLATION THEREOF; AND REPEALING ORDINANCE NO. ____________ AND ALL OTHER ORDINANCES AND PARTS OF ORDINANCES IN CONFLICT THEREWITH.

BE IT ORDAINED BY THE CITY (TOWN) COUNCIL OF THE CITY (TOWN) OF ______________________________:

Section 1. For the purpose of this Ordinance the following definitions shall apply:

1.1 "Agency" shall mean the Metropolitan Area Solid Waste Agency.

1.2 "Garbage" shall mean any and all refuse from food incidental to its preparation or use for human consumption.

1.3 "Refuse" shall mean all solid waste from residential, commercial or industrial premises. It shall include semi-liquid or wet wastes with insufficient moisture and other liquid contents to be free flowing. It shall not include any construction materials except minor amounts incidental to other wastes.

Section 2. By virtue of contract dated ______________, ______ between the City (Town) of ________________________ and the Agency; the Agency is authorized to employ such personnel and equipment as are necessary to collect all garbage and refuse from dwellings (specify whether all dwellings, single-family only, etc.) in the City (Town of ________________________, subject to the following terms and conditions:

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2.1 Collections shall be made not less than once a week, at such time and in such areas of the City (Town) as shall be set out in schedules agreed upon by the City Manager (Mayor) and the Agency.

2.2 The City Manager (Mayor) and the Agency are authorized and empowered, jointly, to change or amend such schedules from time to time as they, in their discretion, shall deem necessary.

2.3 Collections may be made either from streets or alleys, where existing, at the discretion of Agency personnel.

2.4 Containers shall be placed out-of-doors at some easily accessible place.

Section 3. Refuse containers and garbage containers shall not be more than 30 gallons nor less than 10 gallons in nominal capacity; except where only one container is used, in which case this container may be less than 10 gallons in capacity. Containers shall be waterproof and fitted with a tight lid. The containers shall have handles, bails or other suitable lifting devices or features. The containers shall be of a type originally manufactured for refuse or garbage, with tapered sides for easy emptying. They shall be of light weight and sturdy construction. The weight of any individual container and contents shall not exceed 65 pounds. Galvanized iron and similar metal containers, rubber or fiber glass containers, and plastic containers which do not become brittle in cold weather, may be used. Disposable bags manufactured for garbage and refuse disposal in suitable frames or containers shall be acceptable. Oil or grease drums, paint cans, and similar salvaged containers shall not be acceptable.

3.1 All refuse and garbage shall be placed in suitable containers; except, it shall not be necessary to place books, boxes, magazines, or newspapers in containers provided they are securely tied in bundles or completely contained in disposable boxes not larger than 20 x 20 x 36 inches. Also tree limbs and brush may be securely tied in bundles not larger than 48 inches long and 18 inches in diameter.

3.2 Baskets, boxes and non-complying refuse or garbage cans or containers shall be considered disposable refuse and shall be removed by the Agency collection crews if they are the proper size and otherwise acceptable for collection; or shall be left uncollected if they are larger than the allowable size or unacceptable for collection.

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3.3 Large bulky items such as furniture, large tree limbs and appliances that cannot be reduced to fit approved containers, will not be collected.

Section 4. Within the corporate limits of the City (Town) of_______ ____________________, all garbage or refuse, consisting of waste animal and vegetable matter, which may attract flies, dogs or rodents, shall be drained of all excess liquid, wrapped in paper or disposable containers, and placed or stored, until collected, in covered suitable containers as described in Section 3.

Section 5. It shall be unlawful for any person to permit to accumulate on any premises, improved or vacant, or on any public place in the City (Town) of__________________________, such quantities of garbage or refuse, either in containers or not, that shall, in the opinion of the Health Officer, constitute a health or sanitation hazard.

Section 6. It shall be unlawful for any person to permit to accumulate quantities of refuse, papers, trash, ashes, or other waste materials, within or close to any building in the City (Town) of__________________, unless the same is stored in containers in such a manner as not to create a health or fire hazard.

Section 7. No person, firm or corporation shall engage in the business of removing or hauling garbage or refuse from the premises of others unless such person, firm or corporation shall have first applied for and received a permit to do so from the City (Town) Clerk, (License Collector). Application for such permit shall specify the equipment or vehicles to be used, the route to be traveled, the places to be served and the name and address of the applicant. Such person, firm or corporation shall pay an annual license fee of Five Dollars ($5.00) per year for each vehicle engaged in such business to be paid at the office of the City (Town) Clerk, (License Collector) in the City (Town) of__________________, Iowa. Such permit fee shall be payable commencing on the ________day of______ ____________________, 19______, and shall be renewable each year thereafter. All vehicles licensed under this section shall prominently display the license number on the left and right sides of the vehicle in letters not less than 3" high.

Section 8. Any person, firm or corporation authorized and licensed by the Agency to remove or haul, garbage or refuse, shall be considered to have met the provisions of Section 7, and no further permit or license shall be required by the City (Town) of______________________.

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Section 9. No person, firm or corporation shall haul any garbage or refuse upon the streets, alleys or public places of the City (Town) of ______________________ unless the same shall be in approved containers, securely fastened to prevent spillage, or in a totally enclosed water tight vehicle. If, however, the material is a dry type material it may be hauled in a totally enclosed vehicle, or open vehicle which is covered with a suitable tight fitting canvas tarpaulin or similar cover to prevent spillage. Licensed collectors who collect and haul garbage and/or refuse shall haul these materials only in totally enclosed, watertight vehicles or totally enclosed vehicles with water tight containers. All vehicles used for the collection and removal of garbage and refuse shall be kept in a clean, inoffensive and sanitary condition. All garbage and refuse shall be handled in such a way as to prevent the scattering, spilling or leakage of same.

Section 10. No person, firm or corporation shall haul or cause to be hauled any garbage, refuse or other waste material of any kind, to any dumping place or site or area, within or without the corporate limits of the City (Town) of ______________________, unless such place, site or area is first approved by the Agency, or is an Agency operated landfill site; in addition to complying with all applicable health and zoning ordinances of the City (Town) of ______________________.

Section 11. No person, firm or corporation shall deposit in a garbage or refuse container or otherwise offer for Agency collection any hazardous garbage, refuse, or waste. Hazardous materials shall be transported by the owner, responsible person or his agent, to a place of safe deposit or disposal as prescribed by the Agency Director or his authorized representative. Hazardous materials shall include: explosive materials; rags or other waste soaked in volatile and inflammable materials; drugs; poisons; radio active materials, highly combustible materials; soiled dressings, clothing, bedding and/or other wastes, contaminated by infection or contagious disease, and other materials which may present a special hazard to collection or disposal personnel or equipment or to the public.

Section 12. No person, firm or corporation shall throw, rake, deposit, dump, drop or spill litter, waste material or foreign material upon the streets, sidewalks, or other public rights-of-way within the City (Town) of ______________________. However, the Manager (Mayor) may at his discretion proclaim a period when leaves may be placed in street rights-of-way for collection.

Section 13. It shall be the duty of the police department and all police officers of the City (Town) of ______________________, to enforce the provision of this ordinance.

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Section 14. Ordinance No. ___________ and all ordinances or parts of ordinances in conflict with this ordinance are hereby repealed.

Section 15. If any section, subsection, sentence or part of this ordinance is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance.

Section 16. Any person, firm or corporation violating any of the provisions of this ordinance shall upon conviction be subject to a fine of not more than $100.00 or to imprisonment for not more than 30 days.

Section 17. This Ordinance shall be in full force and effect from and after its passage and publication as provided by law.

PASSED AND APPROVED this _________ day of ______________________, 19____.

____
Mayor

Attest:

____
City (Town) Clerk

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EXHIBIT 5-4

METHODS OF DETERMINING A FEE FOR REFUSE DISPOSAL

There are four methods, in common usage, that are used to determine the fees collected for the use of disposal sites. Each method is basically an approach to measuring the quantity of waste as delivered to the landfill site, so that a fee schedule may be adopted which will produce sufficient revenue to support the disposal operation. The four methods include:

1. Fees based on tonnage of waste;
2. Fees based on the gross vehicle weignt;
3. Fees based on the gross volume of the hauling vehicle;
4. Fees based on the volume of the actual waste.

All of these methods have advantages and disadvantages. The tonnage basis is recommended as being the fairest, most accurate and most practical to operate.

This method has the greatest initial cost because a scale house and two sets of scales and equipment must be installed at each site. This cost has been estimated at approximately $58,000 for each site, and is included in the total landfill site development cost presented in Part Four.

Each vehicle is weighed on the entrance scale and the gross weight of the vehicle and load is automatically recorded on the scale mechanism and on a weight ticket. Upon exiting the site, the ticket is transferred to the exit scale where the empty or tare weight of the vehicle is recorded. The net weight of the refuse and the fee is determined and recorded on the ticket automatically. The driver then pays the fee with a credit card, or uses prepaid coupons or may pay in cash.

This method is fair, accurate and convenient. It removes any individual judgment determination by employees or drivers. In addition, an efficient method of record keeping and billing is built into the system.

Determining the fee by gross vehicle weight or by gross volume of vehicle are both similar in procedure and method. They have the advantage of not requiring any initial investment. The inequities in these methods are great. More often than not, the weight or capacity of the vehicle has no bearing on the actual amount of refuse hauled in the vehicle. Customers carrying small or partial loads are penalized while those who overload their vehicles receive a premium. In order to keep customer dissatisfaction to a minimum, a great deal of individual spot adjustments and determinations must be made by the landfill attendant. This leads to a general breakdown of cost and scheduling procedures. These methods are considered satisfactory on an interim or short time basis, where it would not be practical or economical to install scales.

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The method of determining fees by actual volume of the waste is essentially a fair method, similar to the tonnage system. However, this is difficult to do with most vehicles, with any degree of accuracy. It requires a judgment by the attendant, which is always subject to argument with the customer. This method again is satisfactory on a short time basis.

It has previously been recommended that private automobiles be allowed to use the sites without charge. The amount of waste from this source would be negligible in the entire landfill operation. The cost of weighing and collecting from each automobile and the resulting traffic confusion would outweight the value of any revenues that might be collected.

The anticipated tonnages and the disposal cost per ton for the two new landfill sites are shown and discussed in Table 5-1.

EXHIBIT 5-40

U. S. GOVERNMENT PRINTING OFFICE : 1968 O - 326-677